QUALITY ASSURANCE/WORK PLAN

SUSQUEHANNA RIVER BASIN REMOTE WATER QUALITY MONITORING NETWORK

September 19, 2011
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Project Officer: Dawn R. Hintz
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Document Number: QA044

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I. PROJECT NAME

Susquehanna River Basin Remote Water Quality Monitoring Network

II. PROJECT OFFICER

Dawn R. Hintz
Environmental Scientist, Monitoring and Protection Program

III. QUALITY ASSURANCE OFFICER

David W. Heicher
Manager, Research and Grants

IV. DATE OF PROJECT INITIATION

January 1, 2010

V. PROJECT DESCRIPTION

A. Objective and Scope

The objective of the project is for the Susquehanna River Basin Commission (Commission) to remotely monitor water quality conditions to maintain and protect surface waters in select portions of the Susquehanna basin. The monitoring network utilizes state-of-the-art monitoring and communication technology to collect and transmit real-time water quality data. Increasing demands throughout the basin, coupled with increasing wastewater flows, require the application of this advanced technology to effectively monitor rapid changes in water quality conditions.

The current network continuously monitors 56 waterbodies. There exists a need to track water quality conditions within smaller rivers and streams throughout the basin where existing/proposed demands are increasing. This network greatly expands the existing system on the mainstem Susquehanna River to meet a greater need for monitoring any potential changes to water quality conditions in sensitive headwater areas.

This document outlines the quality assurance protocols to be followed by Commission employees for the installation, operation, and maintenance of the remote monitoring system.

B. Data Usage

Data collected for the project will be used for monitoring sensitive headwater areas in the basin susceptible to resource extraction and other potentially harmful activities. The targeted source of pollution will include, but not be limited to, activities related to natural gas development. These data will provide input for the necessary modeling and statistical analyses needed to determine existing conditions, as well as assist with defining any impacts from pollutant sources. Additionally, flow information collected at each of the monitoring stations will assist with enhancing datasets associated with small stream flooding and gaged flows.

C. Monitoring Network Design and Rationale

The map in Figure 1 shows the geographic area of interest for establishment of the network in the Susquehanna River Basin. Station locations are determined after thorough review of existing/proposed natural gas drilling activities, geologic setting, and water quality data/reports. In addition, several stations were chosen to represent reference, or "undisturbed" conditions. The stations will be set up to continuously monitor water quality conditions (~5-minute intervals) in order to monitor any deviations from expected baselines, as well as to characterize water quality during seasonal and/or critical conditions. Data collection efforts will follow the protocols outlined in this report.

As of July 20, 2012, 51 stations have been established within critical areas of the basin. Four more stations are planned for installation by September 30, 2012. The locations of the stations are listed in Table 1. Some of the parameters considered for locating stations in these watersheds include active drilling areas, geologically-sensitive terrain, HQ/EV streams, etc.

Table 1. Station Locations

Map ID	Site	Latitude	Longitude
11	Apalachin Creek near Apalachin, NY	42.062309	-76.148912
50	Baker Run near Glen Union, PA	41.245656	-77.608164
8	Baldwin Creek near Lowman, NY	42.029834	-76.718645
28	Blockhouse Creek near English Center, PA	41.473876	-77.230512
37	Bobs Creek near Pavia, PA	40.263639	-78.592173
29	Bowman Creek near Bowman Creek, PA	41.437356	-76.019779
7	Canacadea Creek near Almond, NY	42.319508	-77.736348
5	Catatonk Creek near Spencer, NY	42.207986	-76.471109
2	Cherry Valley Creek near Middlefield, NY	42.704389	-74.813290
36	Chest Creek near Patton, PA	40.633889	-78.646731
10	Choconut Creek near Vestal Center, NY	42.013212	-76.006881
18	Crooked Creek near Keeneyville, PA	41.842445	-77.276397
47	Driftwood Branch near Lockwood, PA	41.528626	-78.274269
48	East Branch Fishing Creek near Jamison City, PA	41.322608	-76.344340
45	East Fork First Fork Sinnemahoning near Logue, PA	41.565171	-77.933761
26	Elk Run near Watrous, PA	41.741242	-77.579795
43	Grays Run near Gray, PA	41.449967	-77.019786
13	Hammond Creek near Millerton, PA	41.996097	-76.907276
49	Hicks Run near Hicks Run, PA	41.359171	-78.252098
54	*Hunts Run near Cameron, PA	41.452555	-78.174577
52	Kettle Creek near Oleona, PA	41.499699	-77.770681
30	Kitchen Creek near Huntington Mills, PA	41.233925	-76.242743
19	Lackawanna River near Forest City, PA	41.675917	-75.473703
31	Larrys Creek near Salladasburg, PA	41.297237	-77.198020
35	Little Clearfield Creek near Dimeling, PA	40.970096	-78.407436
24	Little Mehoopany Creek near North Mehoopany, PA	41.576019	-76.062424
32	Little Muncy Creek near Moreland, PA	41.189813	-76.654063
44	Little Pine Creek near Waterville, PA	41.309711	-77.362843
22	Long Run near Gaines, PA	41.757800	-77.556588
27	Loyalsock Creek near Ringdale, PA	41.458734	-76.330957
40	Marsh Creek near Ansonia Station, PA	41.763019	-77.413217
33	Marsh Creek near Blanchard, PA	41.059627	-77.606011
20	Meshoppen Creek near Kaiserville, PA	41.619433	-76.008756
51	Moose Creek near Plymptonville, PA	41.082664	-78.507264
4	Nanticoke Creek near Maine, NY	42.204727	-76.053787
39	Ninemile Run near Walton, PA	41.791456	-77.763872
41	Pine Creek near Blackwell, PA	41.647036	-77.450642
38	Pine Creek near Telescope, PA	41.795733	-77.765461
46	Portage Creek near Emporium, PA	41.508256	-78.221674
1	Sangerfield River near Poolville, NY	42.776923	-75.505206
6	Sing Sing Creek near Big Flats, NY	42.104402	-76.921997
15	Snake Creek near Lawsville, PA	41.939238	-75.839256
23	South Branch Tunkhannock Creek near La Plume, PA	41.561004	-75.772126
14	Starrucca Creek near Stevens Point, PA	41.959462	-75.523469
17	Sugar Creek near Troy, PA	41.789669	-76.768459
42	Sugar Run near Sugar Run, PA	41.626436	-76.274356
21	Tioga River near Fall Brook, PA	41.694482	-76.931870
16	Tomjack Creek near Burlington, PA	41.780237	-76.606513
3	Trout Brook near McGraw, NY	42.592774	-76.105889
34	Trout Run near Shawville, PA	41.073591	-78.361176
9	Tuscarora Creek near Woodhull, NY	42.075797	-77.379472
12	Wappasening Creek near Windham Center, PA	41.971849	-76.318317
25	West Branch Pine Creek near Galeton, PA	41.732514	-77.649857
56	West Branch Susquehanna River near Cherry Tree, PA	40.685100	-78.807161
55	West Creek near Weber City, PA	41.508119	-78.242044
53	Young Womans Creek near North Bend, PA	41.400159	-77.685202

*Continuous monitoring station, data are not real-time

D. Station Selection Criteria

Station locations were first selected in-house using GIS ArcMap software. In-house criteria included watershed size (generally 30-60 square miles), non-impaired or minimally impaired waters, and permitted drilling and water withdrawal areas. Reference watersheds were also selected.

After in-house selection of the sites, staff members ground truth the locations. Field criteria include an open area for the solar panel, water deep enough for the data sonde, cellular or satellite service, and securing landowner permission.

E. Continuous Monitoring Equipment Used

Equipment manufactured by YSI, Inc. and Fondriest Environmental:

- iSIC data logger
  - 3100 for cellular sites
  - 6100 for satellite sites
- Solar panel
- 12V rechargeable battery
- SDI-12 field cable to connect to data sonde
- YSI 6600 V2-4 data sonde with YSI probes:
  - Non-vented depth: Range 0-30 feet
  - Optical dissolved oxygen percent saturation: 6150 Optical Dissolved Oxygen Sensor; Accuracy 0-200%
  - Optical dissolved oxygen mg/l: 6150 Optical Dissolved Oxygen Sensor; Accuracy 0-20 mg/l
  - pH: 6579 pH Sensor; Range – 0-14
  - Optical turbidity: 6136 Turbidity Sensor; Range 0-1000 NTU
  - Conductance: 6560 Conductance/Temperature Probe; Range – 0-100 ms/cm
  - Temperature: 6560 Conductance/Temperature Probe; Range – -5-60°C

F. Field Action Plans

An action plan is developed for each station that includes detailed instructions for staff to follow if continuous monitoring data are showing deviations from baseline conditions. An example is shown in Attachment A.

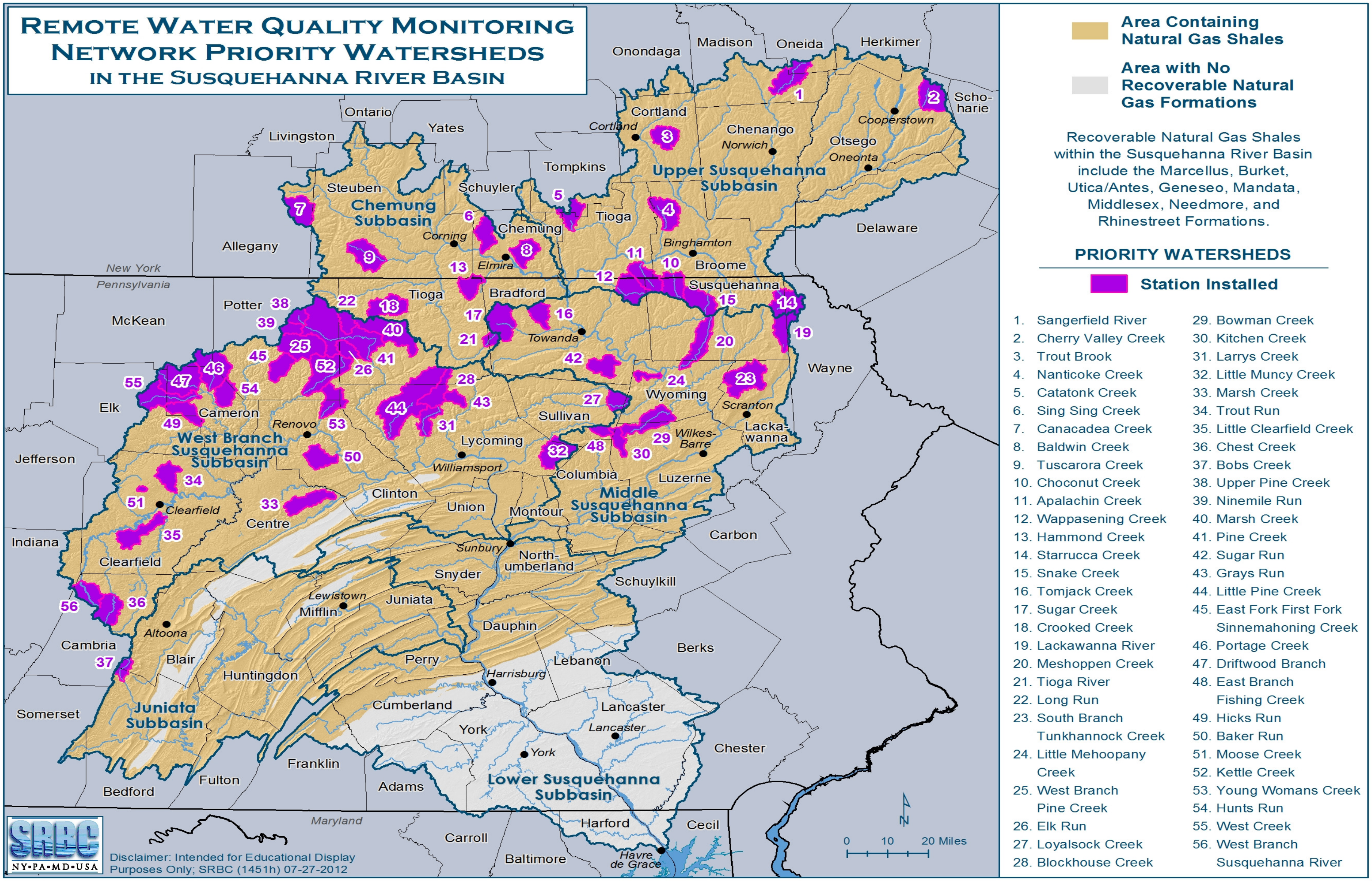


Figure 1. Priority Watersheds

Table 2.   Monitoring Parameters

Parameter	Number of Samples	Analytical Sample Matrix	Method Reference	Report Limit	Sample Preservation	Holding Time
Flow	NA	NA	Buchanan and Somers, 1969	NA	NA	NA
Temperature	TBD	aq.	EPA 170.1[1]	NA	none	0
Dissolved Oxygen	TBD	aq.	EPA 360.1[1]	NA	none	0
Conductivity	TBD	aq.	EPA 120.1[1]	NA	none	0
pH	TBD	aq.	SM 4500H+B[2]	NA	none	0
Turbidity	TBD	aq.	EPA 180.1[1]	0 NTU	none	0
Alkalinity	TBD	aq.	SM20- 2320B[2]	5 mg/l	cooling to 4°C	14 days
Hot Acidity	TBD	aq.	SM20- 2310B[2]	3 mg/l	cooling to 4°C	14 days
Lab pH	TBD	aq.	SM 4500B	0 pH units	cooling to 4°C	24 hours
Suspended Sediment	TBD	aq.	USGS[3]		none	NA
Total Sulfate	TBD	aq.	USEPA 300[4]	2.0 mg/l	cooling to 4°C	28 days
Total Dissolved Solids	TBD	aq.	SM20-2540C[5]	5 mg/l	cooling to 4°C	7 days
Chloride Total	TBD	aq.	EPA 300	2.0 mg/l	cooling to 4°C	28 days
Specific Conductance	TBD	aq.	SM20-2510B	1 umhos/cm	cooling to 4°C	28 days
Total Organic Carbon	TBD	aq.	SM20-5310B	1.0 mg/l	cooling to 4°C	28 days
Barium	TBD	aq.	EPA 200.7	0.005 mg/l	cooling to 4°C	6 months
Calcium, Total	TBD	aq.	EPA 200.7	0.05 mg/l	cooling to 4°C	6 months
Lithium, Total	TBD	aq.	EPA 200.7	0.05 mg/l	cooling to 4°C	6 months
Magnesium, Total	TBD	aq.	EPA 200.7	0.05 mg/l	cooling to 4°C	6 months
Potassium, Total	TBD	aq.	EPA 200.7	0.25 mg/l	cooling to 4°C	6 months
Sodium, Total	TBD	aq.	EPA 200.7	0.25 mg/l	cooling to 4°C	6 months
Strontium, Total	TBD	aq	EPA 200.7	0.0025 mg/l	cooling to 4°C	6 months
Alkalinity, Bicarbonate	TBD	aq.	SM20-2320 B	5 mg/l	cooling to 4°C	14 days
Alkalinity, Carbonate	TBD	aq.	SM20-2320 B	5 mg/l	cooling to 4°C	14 days
Carbon Dioxide, Total	TBD	aq.	SM20-4500-CO2 D	1 mg/l	cooling to 4°C	NA
Nitrate-N	TBD	aq.	EPA 300	0.20 mg/l	cooling to 4°C	48 hours
Bromide	TBD	aq.	EPA 300.1	10.0 ug/l	cooling to 4°C	28 days
Total Phosphorus	TBD	aq.	EPA 365.1	0.01 mg/l	cooling to 4°C	
Total Aluminum	TBD	aq.	EPA 200.7	0.05 mg/l	cooling to 4°C	6 months
Gross Alpha	TBD	aq.	EPA 900.0		cooling to 4°C	6 months
Gross Beta	TBD	aq.	EPA 900.0		cooling to 4°C	6 months
Macroinvertebrates	NA	NA	Barbour and others, 1999	NA	preserve in denatured alcohol	1 year

1. Methods for the Determination of Inorganic Substances in Environmental Samples (EPA/600/R-93/100)
2. Standard Methods for the Examination of Water and Wastewater, 20th edition
3. Laboratory Theory and Methods for Sediment Analysis, USGS TWRI 5-C1 (Guy, 1969)
4. EPA Test Method 375.2, Determination of Sulfate by Automated Colorimetry, Revision 2.0, August 1993
5. Methods for Determination of Inorganic Substances in Water and Fluvial Sediments, USGS

D. Monitoring Parameters

Parameters of interest are listed in Table 2. Discharge will be measured manually at most stations during the sampling visits using standard U.S. Geological Survey (USGS) equipment and methods (Buchanan and Somers, 1969), when possible. Discharge at sites adjacent to USGS gaging stations will be obtained from USGS rating tables. Macroinvertebrate samples will be collected during the appropriate

seasonal conditions, depending on the critical conditions defined for the station location. The macroinvertebrate data will be comprised of a list of different genera collected and a numerated subsample. The samples will be processed and identified by Commission staff and/or subcontractors. Chemical water quality will be collected during the appropriate seasonal and critical conditions for proper characterization of the targeted pollutant sources. Chemical water quality samples will be processed and analyzed by Analytical Laboratory Services, Inc. (ALS), in Middletown, Pa. All analyses performed by ALS adhere to their QA/QC procedures and follow the requirements of their PADEP-accredited lab certification.

VI. PROJECT FISCAL INFORMATION

See Commission financial reports. For the start-up of the project, funds were provided from the Commission's general operating fund and a donation from East Resources, Inc. Funds for expansion of the network were provided by the Pennsylvania Department of Conservation and Natural Resources (PADCNR), New York State Energy Research and Development Authority, and the RC&D Sinnemahoning Grant Program. The ongoing operation and maintenance will be primarily funded through the Commission's compliance monitoring fund, as well as funding support from PADCNR for select stations on state forest lands.

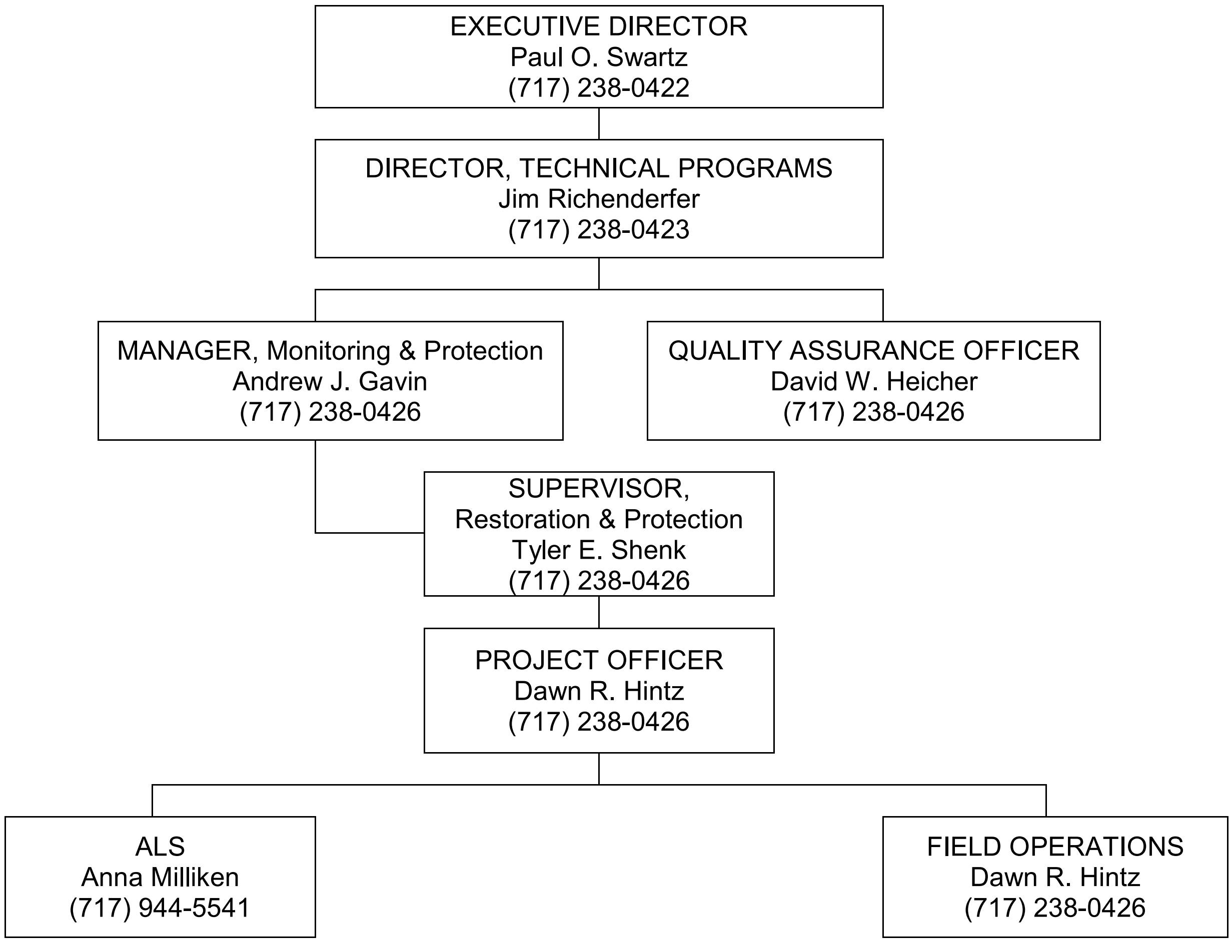
VII. SCHEDULE

	Fiscal Year 2012											
Activity	**J**	**A**	**S**	**O**	**N**	**D**	**J**	**F**	**M**	**A**	**M**	**J**
Coordination/Field Recon	X	X										
Equipment Acquisition	X	X										
Station installation	X	X										
Environmental sampling		X		X		X		X		X		X
Data analysis	X	X	X	X	X	X	X	X	X	X	X	X
Bi-annual report	X	X							X	X	X	X

	Fiscal Year 2013											
Activity	**J**	**A**	**S**	**O**	**N**	**D**	**J**	**F**	**M**	**A**	**M**	**J**
Coordination/Field Recon	X	X	X									
Equipment Acquisition	X	X	X									
Station installation	X	X	X	X								
Environmental sampling	X		X	X	X		X		X		X	
Data analysis	X	X	X	X	X	X	X					
Bi-annual report				X	X	X	X	X	X			

VIII. PROJECT ORGANIZATION AND RESPONSIBILITY

A. Project Organization



B. Project Responsibility

1. Installation operations—D. Hintz, SRBC
2. Sampling operations—D. Hintz, SRBC
3. Sampling QC—D. Hintz, SRBC
4. Laboratory analysis—D. Brooks, ALS
5. Laboratory QC—A. Milliken, ALS
6. Data processing activities—D. Hintz, SRBC
7. Data processing QC—D. Hintz, SRBC
8. Data quality review—D. Hintz, SRBC
9. Performance auditing—D. Heicher, SRBC
10. Systems auditing—D. Hintz, SRBC
11. Overall QA—D. Heicher, SRBC
12. Overall project coordination—A. Gavin, SRBC

IX. DATA QUALITY REQUIREMENTS AND ASSESSMENTS

Table 3. Data Quality Requirements and Assessments

Parameter	Detection Limit (mg/l)	Accuracy[1]	Precision[2]
Total Dissolved Solids	2.0	+/-10%	+/-10%
Macroinvertebrates	NA	NA	+/-10%

1. Calculate accuracy using the formulas:

   For matrix spikes: $\%R = 100 \times \frac{S - U}{C_{sa}}$

   %R = percent recovery
   S = measured concentration in spiked aliquot
   U = measured concentration in unspiked aliquot
   C_{sa} = actual concentration of spike added

   For standard reference material: $\%R = 100 \times \frac{C_m}{C_{rm}}$

   %R = percent recovery
   C_m = measured concentration of standard reference material
   C_{rm} = actual concentration of standard reference material

2. Calculate precision using the formula: $RPD = \frac{(C_1 - C_2)}{(C_1 + C_2)/2} \times 100$

   RPD = relative percent difference
   C_1 = larger of two observed values
   C_2 = smaller of two observed values

A. Data Representativeness

Water samples will be collected along a transect across the stream with depth-integrating samplers. The depth-integrating sampler will provide a composite of the whole water column. Vertical samples then will be composited in a churn, where the final sample will be withdrawn. This will provide a composite sample representing average stream quality. Sampling will occur in the vicinity of station locations. Macroinvertebrate sampling will occur in the vicinity of the site.

B. Data Comparability

The purpose of this QA plan is to eliminate factors in sampling and analysis that reduce the comparability of data collected at different points in space and time. All sampling, analysis, and processing procedures will be standardized to ensure comparability. Staff holds a field training session each year to reduce variability in data collection techniques. A field training session is held annually in late May or early June.

C. Data Completeness

Collection of 95 percent of the total programmed samples will be deemed as fulfilling the project objectives.

Completeness can be calculated using the formula: $\%C = 100 \times \frac{V}{N}$

%C	=	percent completeness
V	=	number of measurements judged valid
N	=	total number of measurements necessary to achieve a specific statistical level of confidence in decision making

X. SAMPLING PROCEDURES

A. Sample Collection

Water samples will be collected using depth-integrating samplers. Samples will be collected using a hand sampler by wading during low flows or from a bridge during storms. The sampler will be faced upstream into the current to prevent collection of sediments kicked up by the sampler or field personnel. At each station, vertical samples will be collected, composited in a churn splitter, and churned while the sample bottle is filled. The churn will be rinsed between each sample with distilled water and with sample water.

B. Water Samples

The amount of water collected at each station for laboratory analyses will depend on the targeted pollutants (Table 4). Duplicate samples will be collected at a frequency of one per day, or one per 10 samples, whichever is more frequent. The samples will be chilled on ice, and shipped within 24 hours to the lab.

Table 4. Water Samples

Parameter	Bottle Type	Bottle Size	# Bottles	Preservative
Calcium, Potassium, Magnesium, Sodium, Lithium, Strontium, Aluminum	Plastic	250 mL	1	HNO_3
Alkalinity, Carbonate; Alkalinity, Bicarbonate; Carbon Dioxide	Plastic	250 mL	1	
Nitrate, Bromide	Plastic	250 mL	1	
Phosphorus	Plastic	250 mL	1	H_2SO_4
Gross Alpha & Gross Beta	Plastic	1 L	1	HNO_3
Barium	Plastic	250 mL	1	HNO_3
Chloride, Sulfate, Acidity, Total Hot, Spec. Conductance, TDS, pH	Plastic	1 L	2	
Alkalinity	Plastic	500 mL	1	
Total Organic Carbon	Amber Glass	125 mL	1	HCl
Suspended Sediment	Glass	500 mL	1	

C. Field Chemistry

Dissolved oxygen, conductivity, pH, and temperature will be measured using an YSI ProPlus meter with a quarto cable. Turbidity will be measured using a Hach 2100P portable turbidimeter. The probes of all meters will be rinsed with distilled water and sample water prior to collection of water quality data. Temperature, dissolved oxygen, pH, and conductivity will be measured directly in the stream. Turbidity will be measured from the composite water collected as part of the depth/width integrated sample collection. Personnel conducting field chemistry analyses will be required to undergo on-the-job training with an experienced field person. The Quality Assurance Officer will certify that training has been completed during field inspections, as well as through discussions with the trainee, the trainee's supervisor, and the person(s) who provide the field training.

D. Discharge Measurements

At all stations except where a USGS gage is available, flow measurements will be made by field personnel using a pygmy meter, AA meter or a FlowTracker, and standard USGS procedures (Buchanan and Somers, 1969). All staff members will be required to participate in computer-assisted training provided by USGS entitled "Measurement of Stream Discharge by Wading," Water Resources Investigations Report 00-4036, by K.M. Nolan and R.R. Shields and to undergo six months of on-the-job training with an experienced staff member, as well as a yearly field check. The Quality Assurance Officer will certify that training has been completed during field inspections and through discussions as detailed in X.C. above.

E. Macroinvertebrates

Macroinvertebrate assessments are adapted from Rapid Bioassessment Protocol (RBP) III, described by Barbour and others (1999) and Plafkin and others (1989) and follow PADEP's "Instream Comprehensive Evaluation Surveys" (PADEP, 2009). Instream macroinvertebrate sampling will be conducted in the best available riffle/run habitats at each station, where available. Sampling will be conducted using a D-frame net with 500-micron mesh in the best available habitat in the stream reach. Samples will consist of a composite of six (6) kicks from riffle areas in a 100-meter stream reach, with each kick disturbing approximately one (1) square meter immediately upstream of the net for approximately one (1) minute.

All collected specimens will be preserved in 95 percent ethanol and returned to the laboratory for processing. Subsampling and sorting procedures will be based on the 1999 RBP document (Barbour and others, 1999). In the laboratory, composite samples will be sorted into 200-organism subsamples using a gridded pan and a random numbers table. The organisms contained in the subsamples will be identified to genus (except Chironomidae and Oligochaeta), when possible, and enumerated. Benthic macroinvertebrates will be identified by professional biologists, with at least a Bachelor of Science degree in biology, skilled at recognizing most benthos to the family level by sight, and to the genus level with appropriate keys.

After sampling has been completed at a given site, all equipment that has come in contact with the sample will be rinsed thoroughly, examined carefully, and picked free of algae or debris before sampling at the next site.

F. Physical Habitat Assessment

Physical habitat conditions will be assessed at each station during various flow conditions, using a slightly-modified version of the habitat assessment procedure outlined by Barbour and others (1999). Eleven habitat parameters will be field-evaluated at each site and used to calculate a site-specific habitat

assessment score. Physical habitat assessments will be performed for riffle/run or glide/pool areas, depending on stream type. Figure 2 and Table 5 show habitat assessment forms and the criteria used to evaluate habitat in riffle/run streams and Figure 3 and Table 6 show forms and criteria used to evaluate habitat in glide/pool stream types.

G. Sampling Schedule

Field chemistry and discharge measurements will be collected each time a staff member visits a site. Lab chemistry samples are collected every eight-nine weeks to have seasonal data for each site. Macroinvertebrates will be collected once a year between May and October; a habitat assessment will be completed at the same time.

H. Training Records

Training records will be maintained by the Quality Assurance Officer.

I. Location of Additional Equipment

If equipment used to collect water chemistry, discharge measurements, or macroinvertebrate data does not function properly, replacement equipment is located at the SRBC Headquarters building in Harrisburg, Pa.

XI. SAMPLE CUSTODY PROCEDURES

Water quality samples will be delivered to the laboratory by the collectors or shipped to ALS by overnight courier service. A chain of custody sample submission sheet(s) (Attachment A), provided by ALS, will be included for samples sent to the lab by Commission staff. This submission sheet will contain all relevant information about the sample, including collector, date, time, location, and method of preservation (if needed). Sample ID, as well as field chemistry and flow data, will be stored in a field logbook and checked against sample IDs received from the lab. For macroinvertebrate samples, a logbook will be kept containing information regarding the collection, preservation, subsampling, and identification of the macroinvertebrates. The station identification data will be recorded on each macroinvertebrate sample and entered into a logbook in the field. This logbook will be used to track the macroinvertebrate sample though the laboratory process. Commission staff members will be responsible for entering the date and their initials for each sample during processing and identification of the sample.

Riffle/Run Habitat Assessment Sheet

<table>
<tr><td colspan="2">Stream</td><td colspan="4">Date</td></tr>
<tr><td colspan="2">Station ID</td><td colspan="4">Time</td></tr>
<tr><td colspan="2">Sample #</td><td colspan="4">Crew</td></tr>
<tr><td colspan="6">Location Description:</td></tr>
<tr><td colspan="6">Stream type: Limestone Sandstone Valley Headwater Large River Glacial Other ____________________</td></tr>
<tr><td colspan="2">Habitat Assessment</td><td colspan="4">Weather Conditions</td></tr>
<tr><td>Parameter</td><td>Score</td><td colspan="2">Air Temperature ©</td><td colspan="2">___________________</td></tr>
<tr><td rowspan="3">1. Epifaunal Substrate</td><td rowspan="3"></td><td colspan="4">Current Conditions: Sunny Cloudy Partly Cloudy</td></tr>
<tr><td colspan="4">Present Precipitation: None Rain Snow Mixed Precip.</td></tr>
<tr><td colspan="4">Heavy? (> 1 inch) Yes No</td></tr>
<tr><td rowspan="3">2. Instream Cover</td><td rowspan="3"></td><td colspan="4">Precip. Within Last 24 Hours: None Rain Snow Mixed Precip.</td></tr>
<tr><td colspan="4">Heavy? (> 1 inch) Yes No</td></tr>
<tr><td colspan="4">Ice Present at Site? Yes No</td></tr>
<tr><td>3. Embeddedness</td><td></td><td colspan="4" rowspan="4">Functionally Important Stream Characteristics</td></tr>
<tr><td>4. Velocity/Depth Regimes</td><td></td></tr>
<tr><td>5. Sediment Deposition</td><td></td></tr>
<tr><td>6. Channel Flow Status</td><td></td></tr>
<tr><td>7. Channel Alteration</td><td></td><td colspan="4" rowspan="2">Predominant Substrate Material (circle one)
Bedrock (> 160 inches in diameter)
Boulder (10 – 160 inches in diameter)
Cobble (2.5 – 10 inches in diameter)
Gravel (0.1 – 2.5 inches in diameter)
Sand/Silt/Clay (< 0.1 inches in diameter)</td></tr>
<tr><td>8. Frequency of Riffles</td><td></td></tr>
<tr><td rowspan="3">9. Condition of Banks (Score each bank)</td><td rowspan="3"></td><td>Residential</td><td></td><td>Commercial</td><td></td></tr>
<tr><td>Industrial</td><td></td><td>Cropland</td><td></td></tr>
<tr><td>Nursery</td><td></td><td>Pasture</td><td></td></tr>
<tr><td rowspan="2">Left Bank</td><td rowspan="2"></td><td>Abd. Mining</td><td></td><td>Old Fields</td><td></td></tr>
<tr><td>Forest</td><td></td><td>Other</td><td></td></tr>
<tr><td>Right Bank</td><td></td><td colspan="4" rowspan="5">Comments:</td></tr>
<tr><td>10. Vegetative Protective Cover (score each bank)</td><td></td></tr>
<tr><td>Left Bank</td><td></td></tr>
<tr><td>Right Bank</td><td></td></tr>
<tr><td>11. Riparian Vegetative Zone Width (score each bank)</td><td></td></tr>
<tr><td>Left Bank</td><td></td><td>Temp.</td><td>Cond.</td><td colspan="2">D.O.</td></tr>
<tr><td>Right Bank</td><td></td><td>pH</td><td>Acid.</td><td colspan="2">Alk.</td></tr>
</table>

Figure 2. Riffle/Run Habitat Assessment Sheet

Table 5. Riffle/Run Habitat Assessment Criteria

Habitat Parameter	Category			
	Optimal (20-16)	**Suboptimal (15-11)**	**Marginal (10-6)**	**Poor (5-0)**
1. Epifaunal Substrate	Well-developed riffle/run; riffle is as wide as stream, and length extends 2 times the width of stream; abundance of cobble	Riffle is as wide as stream, but length is less than 2 times width; abundance of cobble; boulders and gravel common	Run area may be lacking; riffle not as wide as stream, and its length is less than 2 times the stream width; some cobble present	Riffle or run virtually nonexistent; large boulders and bedrock prevalent; cobble lacking
2. Instream Cover	>50% mix of boulders, cobble, submerged logs, undercut banks or other stable habitat	30–50% mix of boulder, cobble, or other stable habitat; adequate habitat	10–30% mix of boulder, cobble, or other stable habitat; habitat availability less than desirable	<10% mix of boulder, cobble, or other stable habitat; lack of habitat is obvious
3. Embeddedness	Gravel, cobble, and boulder particles are 0–25% surrounded by fine sediments	Gravel, cobble, and boulder particles are 25–50% surrounded by fine sediments	Gravel, cobble, and boulder particles are 50–75% surrounded by fine sediments	Gravel, cobble, and boulder particles are >75% surrounded by fine sediments
4. Velocity/Depth Regimes	All 4 velocity/depth regimes present (slow/deep, slow/shallow, fast/deep, fast/shallow)	Only 3 of 4 regimes present (if fast/shallow is missing, score lower than if missing other regimes)	Only 2 of 4 regimes present (if fast/shallow or slow/shallow are missing, score low)	Dominated by 1 velocity/depth regime
5. Sediment Deposition	Little or no enlargement of islands or point bars, and <5% of the bottom affected by sediment deposition	Some new increase in bar formation, mostly from coarse gravel; 5–30% of the bottom affected; slight deposition in pools	Moderate deposition of new gravel, coarse sand on old and new bars; 30–50% of the bottom affected; sediment deposits at obstructions; moderate deposition of pools prevalent	Heavy deposits of fine material, increased bar development; >50% of the bottom changing frequently; pools almost absent due to sediment deposition
6. Channel Flow Status	Water reaches base of both lower banks and minimal amount of channel substrate is exposed	Water fills >75% of the available channel; or <25% of channel substrate exposed	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed	Very little water in channel and mostly present as standing pools
7. Channel Alteration	No channelization or dredging present	Some channelization present, usually in areas of bridge abutments; evidence of past channelization (>20 yr) may be present, but not recent	New embankments present on both banks; and 40-80% of stream reach channelized and disrupted	Banks shored with gabion or cement; >80% of the reach channelized and disrupted

Table 5. ***Riffle/Run Habitat Assessment Criteria*** *(continued)*

Habitat Parameter	Category			
	Optimal (20-16)	**Suboptimal (15-11)**	**Marginal (10-6)**	**Poor (5-0)**
8. Frequency of Riffles	Occurrence of riffles relatively frequent; distance between riffles divided by the width of the stream equals 5 to 7; variety of habitat	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream equals 7 to 15	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the stream width is between 15-25	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is >25
9. Condition of Banks (score each bank 0-10)	Banks stable; no evidence of erosion or bank failure; little potential for future problems; <5% of bank affected	Moderately stable; infrequent, small areas of erosion mostly healed over; 5-30% of bank in reach has areas of erosion	Moderately unstable, 30-60% of banks in reach have areas of erosion; high erosion potential during floods	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; on side slopes, 60-100% of bank has erosional scars
10. Vegetative Protective Cover (score each bank 0-10)	>90% of the streambank surfaces covered by vegetation; vegetative disruption through grazing or mowing minimal	70-90% of the streambank surfaces covered by vegetation; disruption evident but not affecting full plant growth potential to any great extent	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation	<50% of the streambank surfaces covered by vegetation; disruption is very high; vegetation removed to 5 cm or less
11. Riparian Vegetative Zone Width (score each bank 0-10)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clearcuts, lawns, or crops) have not impacted zone	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally	Width of riparian zone 6-12 meters; human activities have impacted zone only minimally	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities

Glide/Pool Habitat Assessment Sheet

Stream	**Date**
Station ID	**Time**
Sample #	**Crew**

Location Description:

Stream Type: Limestone Sandstone Valley Headwater Large River Glacial Other __

Habitat Assessment	
Parameter	Score
1. Epifaunal Substrate	
2. Instream Cover	
3. Pool Substrate Characterization	
4. Pool Variability	
5. Sediment Deposition	
6 Channel Flow Status	
7. Channel Alteration	
8. Channel Sinuosity	
9. Condition of Banks (Score each bank)	
Left Bank	
Right Bank	
10. Vegetative Protective Cover (score each bank)	
Left Bank	
Right Bank	
11. Riparian Vegetative Zone Width (score each bank)	
Left Bank	
Right Bank	

Weather Conditions	
Air Temperature (^{o}C)	
Current Conditions: Sunny Cloudy Partly Cloudy	
Present Precipitation: None Rain Snow Mixed Precip.	
Heavy? (> 1 inch) Yes No	
Precip. Within last 24 Hours: None Rain Snow Mixed Precip.	
Heavy? (>1 inch) Yes No	
Ice Present at Site? Yes No	

Functionally Important Stream Characteristics

Predominant Substrate Material (circle one)

Bedrock (>160 inches in diameter)
Boulder (10-160 inches in diameter)
Cobble (2.5 – 10 inches in diameter)
Gravel (0.1 – 2.5 inches in diameter)
Sand/Silt/Clay (<0.1 inches in diameter)

Residential	%	Commercial	%
Industrial	%	Cropland	%
Nursery	%	Pasture	%
Abd. Mining	%	Old Fields	%
Forest	%	Other	%

Comments:

Temp.	**Cond.**	**D.O.**
pH	**Acid.**	**Alk.**

Figure 3. Glide/Pool Habitat Assessment

Table 6. Glide/Pool Habitat Assessment Criteria

Habitat Parameter	Category			
	Optimal (20-16)	**Suboptimal (15-11)**	**Marginal (10-6)**	**Poor (5-0)**
1. Epifaunal Substrate	Preferred benthic substrate abundant throughout stream site and at stage to allow full colonization (i.e., log/snags that are not new fall and not transient)	Substrate common, but not prevalent or well-suited for full colonization potential	Substrate frequently disturbed or removed	Substrate unstable or lacking
2. Instream Cover	>50% mix of snags, submerged logs, undercut banks or other stable habitat; rubble, gravel may be present	30-50% mix of stable habitat; adequate habitat for maintenance of populations	10-30% mix of stable habitat; habitat availability less than desirable	Less than 10% stable habitat; lack of habitat obvious
3. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present	All mud or clay or sand bottom; little or no root mat; no submerged vegetation	Hard-pan clay or bedrock; no root mat or vegetation
4. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present	Majority of pools large-deep; very few shallow	Shallow pools much more prevalent than deep pools	Majority of pools small-shallow or pools absent
5. Sediment Deposition	Less than 20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of island or point bars	20-50% affected; moderate accumulation; substantial sediment movement only during major storm event; some new increase in bar formation	50-80% affected; major deposition; pools shallow, heavily silted; embankments may be present on both banks; frequent and substantial movement during storm events	Channelized; mud, silt, and/or sand in braided or non-braided channels; pools almost absent due to substantial sediment deposition
6. Channel Flow Status	Water reaches base of both lower banks and minimal amount of channel substrate is exposed	Water fills >75% of the available channel; or <25% of channel substrate exposed	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed	Very little water in channel and mostly present as standing pools

Table 6. Glide/Pool Habitat Assessment Criteria (continued)

Habitat Parameter	Category			
	Optimal (20-16)	**Suboptimal (15-11)**	**Marginal (10-6)**	**Poor (5-0)**
7. Channel Alteration	No channelization or dredging present	Some channelization present, usually in areas of bridge abutments; evidence of past channelization (>20 yr) may be present, but not recent	New embankments present on both banks; and 40-80% of stream reach channelized and disrupted	Banks shored with gabion or cement; >80% of the reach channelized and disrupted
8. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line.	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long time.
9. Condition of Banks (score each bank 0-10)	Banks stable; no evidence of erosion or bank failure; side slopes generally <30%; little potential for future problems; <5% of bank affected	Moderately stable; infrequent, small areas of erosion mostly healed over; side slopes up to 40% on one bank; slight erosion potential in extreme floods; 5-30% of bank in reach has areas of erosion	Moderately unstable; moderate frequency and size of erosional areas; side slopes up to 60% on some banks; high erosion potential during extremely high flow; 30-60% of bank in reach has areas of erosion	Unstable; many eroded areas; “raw” areas frequent along straight sections and bends; on side slopes; side slopes >60% common; 60-100% of bank has erosional scars
10. Vegetative Protective Cover (score each bank 0-10)	>90% of the streambank surfaces covered by vegetation; vegetative disruption through grazing or mowing minimal	70-90% of the streambank surfaces covered by vegetation; disruption evident but not affecting full plant growth potential to any great extent	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation	<50% of the streambank surfaces covered by vegetation; disruption is very high; vegetation removed to 5 cm or less
11. Riparian Vegetative Zone Width (score each bank 0-10)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clearcuts, lawns, or crops) have not impacted zone	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally	Width of riparian zone 6-12 meters; human activities have impacted zone only minimally	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities

XII. CALIBRATION PROCEDURES AND PREVENTATIVE MAINTENANCE

A. YSI ProPlus Meter with Quatro Cable – pH, Conductance, and Dissolved Oxygen

A YSI ProPlus meter will be calibrated daily. The dissolved oxygen probe will be saturated in air in the calibration cap and the barometric pressure from the meter is entered for calibration. The pH probe is calibrated to two of the following three standards: 4, 7.01, and 10.01. The conductance probe is calibrated using the following standards: 1000. Results will be recorded in the calibration log.

B. Flow Meter

For the FlowTracker, the Automatic QC Test will be run once daily to insure proper functioning. Pygmy and AA current meters will be sent to the manufacturer for calibration, as necessary. Spin tests will be performed before and after each day of use. These results will be recorded in the calibration log.

C. Turbidity Meter

The turbidity meter will be calibrated weekly against two standards. The calibration standards used will include <0.10, 20, and 100 NTU solutions. Calibration checks will be made after every 20 samples. These checks will be recorded in the calibration log.

XIII. DOCUMENTATION

Water and macroinvertebrate sample bottles will be labeled at the time of collection. Water samples will be labeled with the station name, date, and time, and whether any fixatives were added to the sample. This information will be recorded on chain of custody sample submission sheets (Attachment A). One copy will be submitted to the laboratory with the sample, while another will be retained as a record. In addition to laboratory submission sheets, Commission staff will maintain a log book that contains information for each water quality sample, in which the station name, date, time, flow measurement at the time of sample collection (if applicable), field chemistry parameters, whether a sample is a duplicate, and any other pertinent information regarding the sample.

Chemical data from the laboratory will be reported electronically to the Commission from ALS. Results of laboratory analyses will be imported into a computer database by a Commission staff member. Data entries will be verified by the project manager, and reductions will be performed using computer files to eliminate transcription errors. Field chemistry and laboratory analysis sheets will be retained for a period of two years and subsequently archived.

Staff has developed an Access database for data storage and to assist in transferring station information, chemical water quality, physical habitat, and macroinvertebrate data to USEPA's Water Quality Exchange (WQX) database. The Access database is located on the Commission's server, which will be backed-up daily.

Macroinvertebrate bottles will be labeled with the station and date. A logbook will be kept for all sites, containing information on the macroinvertebrate sample collection, such as station number, stream name, date, the number of bottles, and the person who collected the sample. Benthic macroinvertebrates will be identified by professional biologists, with a minimum of a Master of Science degree in biology, skilled at recognizing most benthos to the family level by sight, and to the genus level with appropriate

keys. Log sheets (Figure 4) will be used to record the number of specimens for each genus identified. This information will be entered into the Access database and verified.

XIV. DATA REDUCTION

The data will be analyzed using the appropriate methods, depending on the targeted parameters. All continuously monitored parameters will be corrected for post-calibration drift using both field measurements and post-deployment lab analysis using Aquarius software. A standard operating procedure has been developed for data correction.

Data reduction procedures for macroinvertebrates will be similar to those described in RBP III (Barbour and others, 1999). The data for each station will be reduced to the following metrics: (1) taxa richness; (2) modified Hilsenhoff Biotic Index; (3) percent Ephemeroptera; (4) percent contribution of dominant taxon; (5) number of Ephemeroptera/Plecoptera/Trichoptera taxa; (6) percent Chironomidae; and (7) Shannon-Wiener Diversity Index. Staff will utilize PADEP's and New York State Department of Environmental Conservation's (NYSDEC's) Index of Biotic Integrity, as appropriate. Habitat information will be evaluated using PADEP's methodology.

MACROINVERTEBRATE ENUMERATION LIST

SITE __________________________ **DATE SAMPLED____________________**
IDENTIFIED BY: ______________ **DATE IDENTIFIED: ________________**

FAMILY/GENUS	NUMBER OF INDIVIDUALS
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	
13.	
14.	
15.	
16.	
17.	
18.	
19.	
20.	
21.	
22.	
23.	
24.	
25.	
26.	

Figure 4. Benthic Macroinvertebrate Enumeration Sheet

XV. DATA VALIDATION

Primary responsibility for data validation will lie with the project officer. The collectors may assist the project officer in determining the acceptability of the data based on their knowledge of the stream conditions. Field collections will be conducted according to the above methodology to insure accurate data. The use of duplicates, reviewed by the project officer, also will validate the water quality analyses. The data will go through a series of validations as they are entered into the database, including checking values for duplicate samples against one another, comparing computer entries to field and laboratory data sheets, looking for data gaps and missing information, checking flow calculations, and examining raw data for outliers or inappropriate measurements. A separate staff member also will check the information after input to ensure correct data entry.

Ten percent of the macroinvertebrate samples identified by one biologist will be validated by a second biologist and recorded in the logbook. A biologist also will spot-check 10 percent of the samples picked by laboratory personnel during subsampling and will record the samples in the logbook. Percent Taxonomic Determination will be calculated for validation samples.

XVI. PERFORMANCE AND SYSTEMS AUDITS

A. Laboratory Analyses

Analytical and quality assurance procedures for ALS are detailed in the QA plan submitted by the laboratory. The laboratory will analyze a matrix spike/matrix spike duplicate at a frequency of one per 10 samples per matrix. Duplicate samples will be submitted to the laboratory (at least one per 10 samples).

B. Field Procedures

Field operator techniques will be tested annually for pH and specific conductance with USGS standard samples. In addition, Commission staff will be tested annually in the collection of flow measurements. The project officer will be responsible for insuring that all field personnel are competent in measurement and collection techniques prior to fieldwork. The project officer also will be responsible for insuring the quality of all equipment and reagents. The quality assurance officer will perform a field audit near the beginning of sampling. The field audits for this project regularly occur in June of each year, weather and stream flows permitting.

C. Biological Sampling

A second biologist will verify the identifications on 10 percent of the sorted samples.

D. Reporting

A summary of performance and system audits will be included in the applicable annual report document.

XVII. CORRECTIVE ACTION

Implementation of corrective action involving any of the sampling procedures, equipment, or data reduction and processing will be the responsibility of the project officer and must be reported to the Quality Assurance Officer. The Quality Assurance Officer will be responsible for seeing that such corrective action is taken. Implementation of corrective action involving laboratory analyses will be the responsibility of the laboratory analysis officer, with oversight by the laboratory quality control officer.

The results of any corrective actions taken will be documented by the individual(s) taking the necessary actions.

XVIII. REPORTS

The results of the monitoring program will be published in an annual technical report. This report will include a description of the methods and data analysis. Data summaries will be provided, as appropriate, within the annual technical report. The data will be available on the Commission's web site.

XIX. DATA QUALITY OBJECTIVES

The intent of the project is to characterize and track water quality conditions in areas experiencing intense natural gas development activities. Additionally, the project data will add significant value to defining and characterizing a range of water resource related issues, including but not limited to, acid rain impacts, low flow impacts, cumulative point source impacts, urban/agriculture stormwater runoff, climate change, etc.

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Attachment A: Sample Field Action Plan

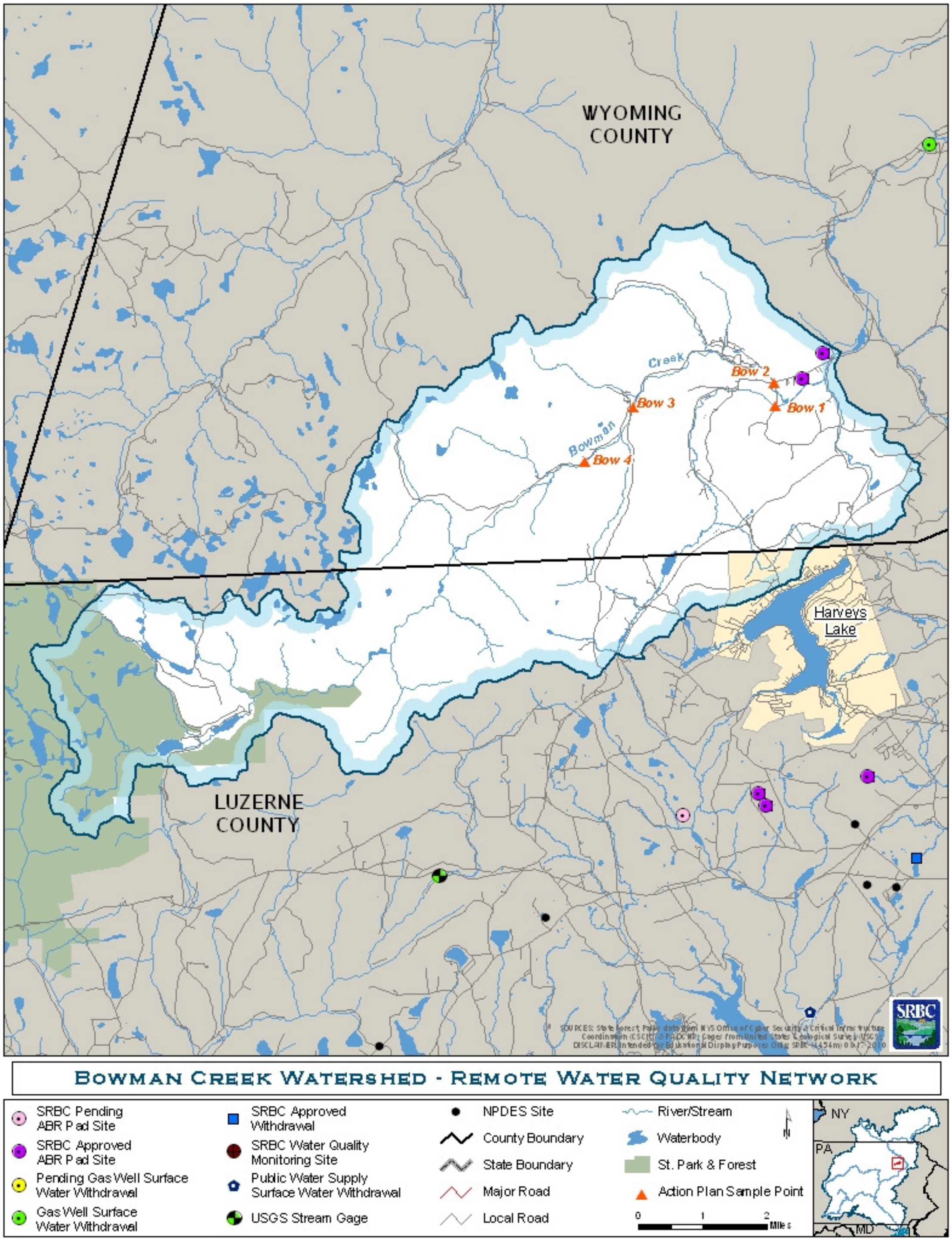
Bowman Creek Action Plan

Unknown reason for parameter deviation from normal:

- Check field parameters on site to see if continuous monitoring probes are the issue:
    - pH
    - Turbidity
    - Temp
    - DO
    - Conductance
- Replace the sonde if probes are determined to be the issue
- Collect a lab sample if it appears the probes are **not** the issue:
    - 2 – 1L bottles not fixed
    - 1 – 1L bottles fixed (Gross Alpha & Beta)
    - 1 – 125 ml amber glass bottle fixed (TOC)
    - 1 – 500 ml bottle not fixed
    - 2 – 250 ml bottles not fixed (one says nitrate and the other is for Alk)
    - 2 – 250 ml bottles fixed (both say metals)
    - Take a discharge measurement
- Work upstream checking the field chemistry on tribs and the mainstem
    - GPS any new location selected
- Upstream sites to sample (see map for visual)
    - Bow 1: (Trib) 41.415203, -76.047827
    - Bow 2: 41.420705, -76.048104
    - Bow 3: 41.415278, -76.090267
    - Bow 4: 41.403454, -76.104874
    - Continue upstream if needed
    - Sample sites in between if needed
- Contact appropriate state agencies regarding Commission initiation of a state action plan

Items needed to sample:

- Churn
- Depth-integrated sampler (take hand-held and bridge sampler)
- Sample bottles
- Cooler with ice
- Meters (pH, turbidity, conductance, DO, and temp)
- Flow-tracker
- Tape measure
- GPS
- Replacement sonde
- Gloves


WYOMING
COUNTY
LUZERNE
COUNTY
Bowman
Creek
Bow 1
Bow 2
Bow 3
Bow 4
Harveys
Lake
SRBC
BOWMAN CREEK WATERSHED - REMOTE WATER QUALITY NETWORK
SRBC Pending ABR Pad Site
SRBC Approved ABR Pad Site
Pending Gas Well Surface Water Withdrawal
Gas Well Surface Water Withdrawal
SRBC Approved Withdrawal
SRBC Water Quality Monitoring Site
Public Water Supply Surface Water Withdrawal
USGS Stream Gage
NPDES Site
County Boundary
State Boundary
Major Road
Local Road
River/Stream
Waterbody
St. Park & Forest
Action Plan Sample Point
0
1
2
Miles
NY
PA
MD

Attachment B: Analytical Laboratory Services, Inc. Chain of Custody Submission Sheet

Analytical Laboratory Services, Inc.
Environmental • Industrial Hygiene • Field Services
34 Dogwood Lane • Middletown, PA 17057 • 717.944.5541 • Fax: 717.944.1430

CHAIN OF CUSTODY/ REQUEST FOR ANALYSIS

ALL SHADED AREAS MUST BE COMPLETED BY THE CLIENT / SAMPLER. INSTRUCTIONS ON THE BACK.

Page ___ of ___
Courier:
Tracking #:
COC#

Co. Name:
Contact (Report to): Phone:
Address:

Bill to (if different than Report to): PO#:

Project Name/#: ALSI Quote #:

TAT: [ ] Normal-Standard TAT is 10-12 business days. Date Required:
[ ] Rush-Subject to ALSI approval and surcharges. Approved By:

Email? [ ] -Y
Fax? [ ] -Y No.:

***Container Type
***Container Size
*** Preservative

ANALYSES/METHOD REQUESTED

Sample Description/Location (as it will appear on the lab report)	COC Comments	Sample Date	Military Time	*G or C	**Matrix	Enter Number of Containers Per Analysis									
1															
2															
3															
4															
5															
6															
7															
8															

Receipt Information (completed by Sample Receiving)
Performed by: INITIAL HERE
Cooler Temp:
Therm. ID:
No. of Coolers:
Notes:

Circle appropriate Y or N.

	Y	N
Correct containers?	Y	N
Correct sample volume?	Y	N
Correct preservation?	Y	N
Headspace/Volatiles?	Y	N
Custody seals Present?	Y	N
(if present) Seals intact?	Y	N
Received on ice?	Y	N
COC/Labels complete/accurate?	Y	N
Container in good condition?	Y	N

SAMPLED BY (Please Print):
LOGGED BY(signature): DATE: TIME:
REVIEWED BY(signature): DATE: TIME:

Relinquished By / Company Name	Date	Time	Received By / Company Name	Date	Time
1			2		
3			4		
5			6		
7			8		
9			10		

Data Deliverables: [ ] Standard [ ] CLP-like [ ] NJ-Reduced [ ] NJ-Full (other) [ ]
EDDs Required? [ ] If yes, format type:
DOD Criteria Required?

SDWA Forms? yes [ ] yes [ ] yes [ ] yes [ ]
Other
PWSID

State Samples Collected In? MD [ ] NJ [ ] NY [ ] PA [ ]

ALSI FIELD SERVICES
[ ] Pickup
[ ] Labor
[ ] Composite Sampling
[ ] Rental Equipment
[ ] Other:

* G=Grab; C=Composite **Matrix: Al=Air; DW=Drinking Water; GW=Groundwater; Ol=Oil; OL=Other Liquid; SL=Sludge; SO=Soil; WP=Wipe; WW=Wastewater

Copies: WHITE - ORIGINAL CANARY - CUSTOMER COPY ***Container Type: AG-Amber Glass; CG-Clear Glass, PL-Plastic. Container Size: 250ml, 500ml, 1L, 8oz., etc. Preservative: HCl, HNO3, NaOH, etc.

Rev 08-2008

Attachment C: Standard Operating Procedure – Remote Water Quality Monitoring Network

Standard Operating Procedure – Remote Water Quality Monitoring Network

Site Selection
Data Sonde
Datalogger
Data Correction

Table of Contents

TABLES

FIGURES

ATTACHMENTS

I. SITE SELECTION

A. Region

Hydrocarbon shale regions in Susquehanna River basin

B. In-house Site Selection Criteria

- GIS used to locate suitable watersheds
- 30-60 square mile watershed
- Nonimpaired waters (or minimally impaired)
- Permitted drilling and water withdrawal activities

Once watersheds are selected in-house, field crews will ground truth the locations to ensure the watershed is suitable for monitoring equipment.

C. Field Site Selection

- Site access and permission (sites can be located on private and public lands)
- Canopy cover – solar panels power the battery to collect and transmit data
- Suitable instream location for PVC casing
    - Flowing water
    - Water deep enough to sustain flow year-round
- Cellular 3G coverage – used to determine if a cell or satellite datalogger unit is needed
- Distance from instream location to proposed datalogger location is measured to order the correct SDI-12 cable length

D. Reference Watersheds

- Selected using the same watershed size criteria (30-60 mi^2)
- No current or planned drilling activities
- Non-impaired waterbodies

II.iSIC DATA LOGGER

Two models of iSIC data loggers are used. The cell telemetry units are model 3100 iSIC and the satellite telemetry units are model 6100 iSIC. The basic operation and programming of the units are similar and unless noted otherwise, the same procedure is performed on both models of data loggers.

A. Unpacking/Preparation

- Equipment List
    - Insulated spade terminal electrical connectors

- o Wire cutters
  - o Wire stripper
  - o Wire crimper
  - o Flying lead cable (MS 8 to flying lead adapter)
  - o Phillips head screwdriver
  - o Power source (12-volt Battery or Float Charger with MS 2 connector)
  - o SDI-12 cable
  - o Sonde
  - o Direct connect cable (UBS to male DB 9)
  - o Small flathead screwdriver
  - o Computer with iChart software
  - o Internet connection

- Extra hardware is removed from the unit and stored for later use.
- The unit is checked for damage or missing parts.
- Flying lead cable is run into the steel enclosure through a gland fitting and connected if necessary.
  - o If the flying lead cable was shipped without having insulated spade terminal electrical connectors attached:
    - ▪ The unused wire (blue, gray, green and silver) are cut to varied lengths to avoid creating unwanted connections.
    - ▪ The remaining wires of the flying cable (red, black, yellow, orange and either purple or brown) are cut and stripped using the strained 22 opening.
    - ▪ The insulated spade terminal electrical connectors are crimped in place.
  - o The flying lead is connected to the terminal strip on the left side of the steel enclosure following wiring tables (Tables 1 and 2).

Table 1. YSI Flying Lead Cable Wiring

MS8 Connectors	YSI Sonde Signal	Cable Color	iSIC Cable Color	iSIC Signal
A	PWR IN (5-16V)	RED	RED	3. BAT
B	GND	BLACK	BLACK	4. GND
C	SONDE Tx	YELLOW	YELLOW	5. P1.Rx
D	SONDE Rx	ORANGE	ORANGE	6. P1.Tx
E	ALARM	GREEN	BLUE	11. P3.Rx
F	SDI-12	PURPLE	BROWN	1. SDI
G	RTS	GRAY	GREEN	12. P3.Tx
H	CTS	BLUE	WHITE	2. SW.A

Table 2. Nexsens Flying Lead Cable Wiring

MS8 Connectors	YSI Sonde Signal	Cable Color	iSIC Cable Color	iSIC Signal
A	PWR IN (5-16V)	RED	RED	3. BAT
B	GND	BLACK	BLACK	4. GND
C	SONDE Tx	YELLOW	YELLOW	5. P1.Rx
D	SONDE Rx	ORANGE	ORANGE	6. P1.Tx
E	ALARM	NA	BLUE	11. P3.Rx
F	SDI-12	BROWN	BROWN	1. SDI
G	RTS	NA	GREEN	12. P3.Tx
H	CTS	NA	WHITE	2. SW.A

- The antenna, either cellular or satellite, is mounted on the steel enclosure and connected to the data platform with the provided micro loss RF cable as necessary.
- Communication is established with data loggers in preparation for programming.
  - Cellular units:
    - The unit is placed in an area with adequate cellular service to support communication. In front of a window works well.
    - If the cellular service is not available or is not strong enough to support communication, the unit is directly connected in the same way as with a satellite unit.
  - Satellite units:
    - The unit is placed close enough to a computer that is being used for programming that the direct connect cable can reach.
    - The RS232 cable is disconnected from the iSIC's DB9 port. A small screwdriver may be needed to loosen the screws.
    - The computer and unit are connected using the direct connect cable.
- A power source is connected to the unit. The power source is either a battery or a float charger.
- The SDI-12 cable is connected to the flying lead cable.
- The 6600V2-4 YSI sonde is connected to the SDI-12 cable.

B. Programming the Data Logger

- Make a copy of RWQN.irc file that is currently in use and located at \\Bass1\iChartData\Users_RWQN.
- Paste the copy of the icr file to desktop of the iChart Toughbook.
- Open iChart program local on the Toughbook.
- Click "Open Without Project."
- Open the File menu select "open project…"
- Browse to the desktop and select RWQN.icr.
- Click "Open."

- Pause Auto-interrogation by clicking on the green circle at the bottom of the navigation panel. The circle will turn red.
- Go to the Project menu and select “Setup Device Wizard…”
- Click next to go to the Site screen.
- Type the desired site name in the “site name” box at the bottom of the dialog window. SRBC uses the format <stream name> near <nearest town>, <State>. Example: March Creek near Blanchard, PA.
- Click “add.”
- Click “next” to go to the Data Logger Screen.
- Select the appropriate site for the list. The top site is selected by default.
- Select “Nexsen” for the drop-down list on the right side of the dialog window.
- Select the appropriate data logger from the list: 3100-iSIC for cellular units and 6100 for satellite units.
- Type the stream name in the “logger name” box. Example: Marsh Creek. If no name is entered, the logger model is the default name and name can be changed later in the navigation panel.
- Click “Add.”
- In the pop-up window:
    - For cellular units:
        - In the Connect Trough box, select “Internet” from the drop-down list.
        - In the data logger Connection box:
            - Make sure the 3100-iSIC address is “0.”
            - Type the unit’s static IP address in the IP Address box (usually found on the back of the data logger’s door).
            - Make sure the IP port is “500.”
        - Make sure the “connect through another iSIC or SDL” box is unchecked.
        - Click “test connection.” If the connection passes, you may continue with programming. If the connection fails, you must isolate the communication problem and correct it. Most common problems are the battery is not connected, the modem was not given enough time to boot-up after the power was supplied to the unit, there is not adequate cellular service, or the static IP address is incorrect.
        - Click “OK.”
    - For Satellite units:
        - In the Connect Trough box, select “Direct to PC” for the drop-down list.
        - In the data logger Connection box, make sure the iSIC address is “0.”
        - In the Direct PC Connection box:
            - Select the connect COM port from the PC COM Port drop-down box. SRBC uses COM 3 or COM 7.
        - Make sure the details box has “COM_,9600 Baus, N81,None” displayed.
        - Make sure the “connect through another iSIC or SDL” box is unchecked.

        - Click “test connection.” If the connection passes, you may continue with programming. If the connection fails, you must isolate the communication problem and correct it. Most common problem are the battery is not connected, the modem was not given enough time to boot-up after the power was supplied to the unit, the direct connect cable is not connected properly, or the incorrect COM port was chosen.
        - Click “OK.”
- Click “Next” to move to the Sensor screen. (The order in which the sensors are added is important. Always add the sonde before the battery.)
- Select the desired data logger. The selected logger is not always the last data logger that was added.
- Select YSI from the drop-down list on the right side of the dialog window.
- Select 6600V2-4 from the list below the drop-down window.
- Click “Add.”
- In the pop-up window:
    - Make sure the port is set to SDI-12 and SDI-12 Address is “0.”
    - Click “Detect.”
    - The parameters should appear in the Selected parameters window in the following order: Temp, SpCond, Depth, pH, Turb, ODOSat%, ODO.
        - If the parameters are not in this order, check to make sure the sonde has its probes in the correct ports and is set-up properly. See the sonde section for more details (Probe Locations on Sonde Bulkhead, Figure 3).
    - Click “OK.”
- Select NexSens from the drop-down list on the right side of the dialog window.
- Select iSIC Battery from the list below the drop-down window.
- Click “Add.”
- In the pop-up window:
    - Check to make sure the iSIC Battery Channel is VBat and the Selected Parameter is “Battery (V).”
    - Click “OK.”
- Click “Next” twice to go to the Log Screen.
- Select the desired data logger from the list. By default, the site at the top of the list is selected. Make sure to select the data logger, not the site.
- Make sure the Log Mode is set to “Time-Based” in the top drop-down list on the right side of the dialog window.
- Set-up the iSIC for a lab test.
    - For cellular units:
        - In the Time based box:
            - Set Log interval to 2.
            - Set Sample interval to 2.
        - In the Log Vale:
            - Choose “instantaneous.”
        - On the Log Memory Mode:
            - Choose “Roll Over.”

- For satellite units:
  - In the Time based box:
    - Set Log interval to 6.
    - Set Sample interval to 2.
  - In the Log Vale:
    - Choose “Average.”
  - On the Log Memory Mode:
    - Choose “Roll Over.”

- Click “Next” to go to the Finish screen.
- Select the desired data logger. By default, the site at the top of the list is selected.
- Click “Program iSIC.”
- Click “Yes” to the iChart message reading “Device ‘<name of datalogger>[<number of datalogger>] has not been programmed. Would you like to program it?”
- Wait for the logger to be programmed.
- Click “OK” to the iChart message “Successfully programmed ‘<logger name and number>’.”
- Click “Finish” to exit the device setup wizard.
- Wait 10 to 15 minutes to allow the data logger to record several measurements.
- Manually interrogate the unit by clicking “interrogate” on the Main Project Window.
- Check to make sure data were received and reported correctly.
- Go to the Advanced menu and select iSIC→ iSIC…
- Establish a connection with the unit.
  - For cellular units:
    - In the PC Settings box:
      - Select “3100-iSIC (Cellular modem) in the connection drop down box.
      - Type the correct static IP address in the IP Address box.
      - Check that the IP Prot box reads “500.”
  - For satellite units:
    - In the PC Settings box:
      - Select “iSIC” (Direct connect) in the connection drop-down box.
      - Select the correct COM port in the PC COM port drop-down box.
        - If the correct port is not listed, click on the “…” button by the Connection line.
        - Select the correct COM port from the Port drop-down box in the pop-up window.
        - Click “OK.”
- Click “Connect.”
- Wait for the “Connect” button to change to “Disconnect” to ensure the connection was made.
- Click on the “Power Schedule” tab.
- Check to make sure and change if necessary:
  - Low bat threshold is set to 11.2.

    - High bat threshold is set to 12.0.
    - If the changes are made, click "Apply."
- Click on the "Logging" tab.
- Set-up unit for field deployment:
    - Check the boxes beside "Erase logging memory," "Log interval (min)," and "sample interval (min)."
    - For cellular units:
        - Set Log interval to 5.
        - Set Sample interval to 5.
    - For satellite units:
        - Set Log interval to 240.
        - Set Sample interval to 5.
- Click "Apply."
- Click "Yes" to the iChart message that reads "Are you sure you want to erase the iSIC logger memory?"
- Wait for the "Apply" button to become grayed out.
- Click the "Connection" tab.
- Click "disconnect."
- Click "Close."
- Disconnect the power source from the data logger to prevent unwanted measurement from being taken in the lab.
- Change the connection methods for satellite units only. Cellular units are ready for use.
    - Select the desired data logger (not site) in the navigational panel.
    - Right-click and select property.
    - Change the Connect through to "Internet" using the drop-down list.
    - In the Datalogger Connection box:
        - Check that 6100-iSIC address is "0."
        - Type the correct IMEI in the IMEI box (IMEI can usually be found on the back of the data platform's door).
    - Click "OK."
- Satellite unit is now ready for deployment.
- Disable the site in iChart by
    - Right-clicking on the site in the navigation panel.
    - Select "disable."
    - Click "Yes" to iChart message "Would you like to add as note to the database?"
    - In the note box, type the name of station, the unique ID number, "was programmed," and your initials for record keeping.
    - Click "OK."
- Close iChart.
- Log onto terminal server as the iChart user.
- Close iChart.
- Browse to the \\Bass1\iChartData\Users_RWQN folder.

- Rename the icr file on the bass1 server to include the date. Example: 01_01_2011RWQN.icr
- Move the renamed file into folder named “back-up icr files” on the Toughbook’s desktop.
- Move the icr file used for programming into the \\Bass1\iChartData\Users_RWQN folder.
- Open the RWQMN iChart project file using the RWQN iChart icon on the iChart user’s terminal server desktop.
- Email the Database Analyst, currently Bret Wagner, that stations have been added and the ODBC connection needs to be set up.

C. iChart

a. Auto-Interrogation and Clock Sync

- Click on the desired station in the Navigation panel.
- In the main display window, click “Schedule…” button at the bottom of the results window.
- On the interrogation schedule tab:
    - Check the enable box.
    - Make sure every day is checked.
    - Select “every” by clicking on the circle next to “every.”
    - Type 120 in the minutes box.
    - Make sure the times in the Between boxes are 12:00:00AM and 11:59:59PM.
    - Type 300 in the Offset (sec) box.
- Click the Snyc RTC Schedule tab.
    - For Satellite units, make sure the Enable box is not checked.
    - For Cellular units:
        - Check the Enable box.
        - Remove check marks from everyday except “Sun.”
        - Select “At” by clicking on circle next to “At.”
        - Place check mark in first time option box.
        - Change time to 03:00:00AM.
        - Type 300 in the Offset (sec) box.
- Click “OK.”

b. Parameter Alarms

Alarms are set up for several parameters on all stations. The process is the same for every alarm. Multiple alarms can be set up for the same parameter at one station. Generic steps are listed. Alarms can be changed at several stations seasonal.

<u>Setting up alarms at the first station</u>

- Select the desired station in the navigation panel.
- Go to the Project menu and select “setup iChart Alarm…”
- Select the desired Parameter from the parameter list.

- Click “Add.”
- Check to make sure the enable box is checked and the alarm circle is dotted.
- In the Alarm Condition section:
    - For all alarms:
        - Data Flag: empty
        - Range condition: unchecked
        - Count: 3
    - High Sp Cond (mS/cm)
        - Type: High threshold
        - Set Value: 1.5 to 2 time baseline average
        - Reset Value: value below set value
    - Low Sp Cond (mS/cm)
        - Type: Low threshold
        - Set Value: 0.01
        - Reset Value: 0.02
    - Depth (ft)
        - Type: Low threshold
        - Set Value: 0
        - Reset Value: 0.5
    - Low pH
        - Type: Low threshold
        - Set Value: based on previously collected data
        - Reset Value: 1.0 unit above set value
    - High pH
        - Type: High threshold
        - Set Value: based on previously collected data
        - Reset Value: 1.0 unit below set value
    - Turbidity + (NTU +)
        - Type: High threshold
        - Set Value: double baseline average
        - Reset Value: a little below set value
    - ODO (mg/l)
        - Type: Low threshold
        - Set Value: based on previously collected data
        - Reset Value: 1.0 unit above set value
    - Battery (V)
        - Type: Low threshold
        - Set Value: 11.5
        - Reset Value: 12.0
- In Alarm Action box, click “…”
    - In the pop-up window:
        - Select “send email message” from the Alarm Action drop-down list.
        - Add desired email addresses to Email Address box putting a semicolon between addresses.
        - Type the following formula in Message box “%p = %f @ %d”.
        - Click “OK.”

- Click “OK” (Define Alert/Alarm window).
- Select next parameter and repeat process as necessary.
- Click “OK” when all alarms have been added.

Setting up Alarms for Data Flags

Data flags are used to filter out invalid or error data. When communication is lost with a data sonde, iChart receives an error code of -99999.99. This value is recognized as an error code and iChart automatically flags and deletes these data. In order to have an alarm email sent a data flag alarm must be set up. The data flag alarm may be set up for any parameter. For this project, it is set up for temperature.

- Select the desired station in the navigation panel.
- Go to the Project menu and select “Setup iChart Alarm…”
- Select Temperature from the parameter list.
- Click “Add.”
- Check to make sure the enable box is checked and the alarm circle is dotted.
- In the Alarm Condition section:
    - Type: Data Flag
    - Data Flag: Delete
    - Range condition: unchecked
    - Count: 1
    - The value field is grayed out.
- In Alarm Action box, click “…”
    - In the pop-up window:
        - Select “send email message” from the Alarm Action drop-down list.
        - Add desired email addresses to Email Address box and put a semicolon between addresses.
        - Type the following formula in Message box: “%d lost communication with sonde.”
        - Click “OK.”
- Click “OK” (Define Alert/Alarm window).
- Click “OK.”

Setting up Alarms for Remaining or Additional Stations

This procedure involves copying the alarms from one station to other stations. You can copy settings to multiple stations at one time. This procedure allows you to save time and eliminates human errors. After the alarms are copied, alarms for turbidity and high specific conductance will need to be edited because they are site-specific alarms.

- Select a station in the navigation panel that has an alarm already set up.
- Go to the Project menu and select “setup iChart Alarm…”

- Click “Copy All…”
- Check all the parameters on the left side of the window.
- Check the station that needs alarms set up on the right side of the window.
- Click “Copy.”
- Click “OK” to the successfully copied message from iChart.
- Click “Close.”
- Click “Cancel.”
- Select the station you are setting the alarm for in the navigation panel.
- Go to the Project menu and select “setup iChart Alarm…”
- Select the either Sp Cond (mS/cm) or Turbidity+ (NTU+) from the parameter list.
- Select the alarm listed in the Alarm/Alert box.
- Click “Edit…”
- Change the set value and Reset values.
- Click “OK.”
- Select the other parameter and repeat last four steps.
- Click “OK” when you are finished editing the alarms.

D. Stations Temporarily Offline

a. Take a Station Offline

The following procedure is used when a cellular station is temporarily offline to avoid collecting large amounts of error values. This cannot be done with satellite stations due to the lack of two-way communication with the data logger. Before completing the steps below, make sure all of the valid data have been retrieved from the unit.

- Right-click on the station’s data logger and select “properties.”
- Select and copy the static IP address.
- Go to the Advanced menu and Select iSIC→ iSIC…
- Select “3100-iSIC (Cellular modem) in the connection drop-down box.
- In the PC Settings box:
    - Click and paste the static IP address in the IP Address box.
    - Check the IP Prot box reads “500.”
- Click “Connect.”
- Wait for the “Connect” button to change to “Disconnect” to ensure the connection was made.
- Click on the “Logging” tab.
- Check the boxes beside “Erase logging memory,” “Log interval (min),” and “sample interval (min).”
- Set log interval to 0.
- Set Sample interval to 0.
- Click “Apply.”
- Click “Yes” to the iChart message that reads “Are you sure you want to erase the iSIC logger memory?”
- Click the “Connection” tab.

- Click “Disconnect.”
- Click “Close.”
- Right-click on the site in the navigation panel.
- Select “Disable.”
- Click “Yes” to iChart message “Would you like to add as note to the database?”
- In the note box, type the station name, unique ID number, reason for the station going offline, and your initials for record keeping.
- Click “OK.”

b. Put a Station Back Online

- Right-click on the station data logger and select “properties.”
- Select and copy the static IP address.
- Go to the Advanced menu and Select iSIC→ iSIC…
- Select “3100-iSIC (Cellular modem)” in the connection drop-down box.
- In the PC Settings box:
  - Click and paste the static IP address in the IP Address box.
  - Check that the IP Prot box reads “500.”
- Click “Connect.”
- Wait for the “Connect” button to change to “Disconnect” to ensure the connection was made.
- Click on the “Logging” tab.
- Check the boxes beside “Log interval (min)” and “sample interval (min).”
- Set log interval to 5.
- Set Sample interval to 5.
- Click “Apply.”
- Click the “Connection” tab
- Click “Disconnect.”
- Click “Close.”
- Right-click on the site in the navigation panel.
- Select “Enable.”
- Click “Yes” to iChart message “Would you like to add as note to the database?”
- In the note box, type the station name, unique ID number, what was done to the logger to put it back online, and your initials for record keeping.
- Click “OK.”

E. Uploading and Importing Data

When direct communication with a box is lost, data must be uploaded directly from a data logger.

a. Uploading

- Direct-connect Toughbook to data logger.
- Open iChart without a project.

- Go to Advanced menu and select iSIC→ "Quick Upload…"
- Check the follow settings in the Connection box:
  - Port: COM7
  - Baus: 9600
  - iSIC Address: 0
- Upload box:
  - Click "…"
  - Browse to the csv data folder on the desktop.
  - Name the file with the station's name and date.
  - Click "Save."
  - Click "Upload."
- If "Fail reading iSIC ID" error message appears, change the COM Port.
- Click "Close" on pop-up window "iSIC Data Upload Statistic" when download is finished.
- Check to make sure data were downloaded correctly:
  - Right-click on the Windows start menu.
  - Select "Explore."
  - Browse to csv data folder on the desktop.
  - Double-click on the correct csv file to open it.
  - Check to make sure all the desired data were downloaded.
  - Close file and explorer window.
- In the iSIC Quick Data Upload window, click "Erase Log Memory."
- Click "Yes" to the iChart message, "Are you sure you want to erase the iSIC logging memory?"
- Click "No" to the iChart message, "Successfully erased iSIC logging memory. Would you like to wait for the first log data record?"
- Click "Exit."

b. Importing

- Copy and paste csv file from Toughbook's desktop to the terminal server's desktop "RWQMN csv data" folder.
- Go to iChart project running on the terminal server.
- Select the desired station.
- Go to File menu and select "Import…"
- Browse to the correct file in the "RWQMN csv data" folder.
- Click "Open."
- Check to make sure correct station and file are selected in the following message: "WARNING: no error checking will be performed. Be sure to select the correct imported file and device to import into. This action is irreversible. Are you sure you want to import file <file name> into device <device name>?"
- Click "Yes" if correct. Click "No" if incorrect and try again.
- Click "OK" to "Successfully Imported Data File."
- Email csv file to the Database Analyst, currently Bret Wagner, so it can be added to SQL database.

F. Firmware Update

- Direct-connect Toughbook to data logger.
- Open iChart without a project.
- Go to the Advanced menu and select iSIC→ "Code update…"
- Select "iSIC (Direct connect)" in the connection drop-down box.
- Select the correct Com port in the PC COM Port drop-down box.
- Click "Next."
- Click "Next" to begin the code update.
- If the iChart message "Fail validating the iSIC bootloader" appears, the wrong COM Port was selected.
    - Click "OK."
    - Click "Close" and try again with a different COM Port.
- Wait for process to be completed.
- Click "OK" when the process is 100% complete.

G. Sync Clock Manually for Satellites

- Go to the Advanced menu and Select iSIC→ "iSIC…"
- In the PC Settings box:
    - Select "iSIC (Direct connect)" in the connection drop-down box.
    - Select the correct COM port in the PC COM port drop-down box.
        - If the correct port is not listed, click on the "…" button by the Connection line.
        - Select the correct COM port from the Port drop-down box in the pop-up window.
        - Click "OK."
- Click "Connect."
- Wait for the "Connect" button to change to "Disconnect" to ensure the connection was made.
- Click on the "General" tab.
- Check the boxes beside "Sync to PC time" in the systems box.
- Click "Apply."
- Wait for the "Apply" button to gray out.
- Click the "Connection" tab.
- Click "Disconnect."
- Click "Close."

III. SITE INSTALLATION

A. Equipment

- iSIC datalogger in a stainless steel enclosure (cellular or satellite telemetry)
- 6600 V2-4 data sonde
- SDI-12 field cable
- Solar panel

- 12V battery
- Grounding kit
- 10-foot section of 4” schedule 80 PVC
    - Holes drilled in the PVC (bottom 2 feet) for flow through
    - Carriage bolt through the bottom of the PVC to stop data sonde from sliding out
    - PVC cap on top
- Coated ¼” wire cable
- Marine grade:
    - Wire clamps
    - Turn buckles
- Hose clamps
- Stainless steel quick link – 2
- 10 foot, 2” steel poles (predrilled with holes 22 inches apart) – 2
- Stainless steel bolts (3/8 ” 2 ½ inch length) – 4
- Stainless steel nuts (3/8”) – 4
- Stainless steel washers (3/8”) – 8
- Concrete (quick setting) – 160-240 pounds (dry)
- Level
- Rebar – 4 foot with top welded into a loop
- Silicon – sealing around drilled holes inside steel enclosure

B. iSIC Datalogger Installation

- At the designated location, two holes are dug 18 inches apart and 36 inches deep.
    - One hole may be dug – minimum of 18 inches wide.
    - If conditions on-site prohibit a depth of 36 inches, a minimum depth of 20 inches is required.
- The iSIC datalogger in the stainless steel enclosure (unit) is attached to the steel poles using the bolts, washers, and nuts.
- The solar panel is partially secured to the top of one of the steel poles (easier to work with on the ground level).
- The steel poles with the attached unit are stood up in the two holes.
- Concrete is poured around the poles; stream water is added if necessary.

- The unit is leveled vertically and horizontally using a level.
- Once level, the holes are backfilled with the soil removed to dig the holes.
- The solar panel is secured on the steel pole and tilted upward.
    - Optimal – face the solar panel south
    - Average – face the solar panel southwest or west
    - Only face the solar panel in other directions if conditions prohibit south or west
- SDI-12 field cable is connected to the unit and run to the instream data sonde. It is trenched just below the ground surface if possible to prevent animal and high flow damage.
- Battery is placed in the steel enclosure and connected to the iSIC datalogger (Figure 1).
- Solar panel cable is ran into the steel enclosure and connected to the panel (Figure 1).

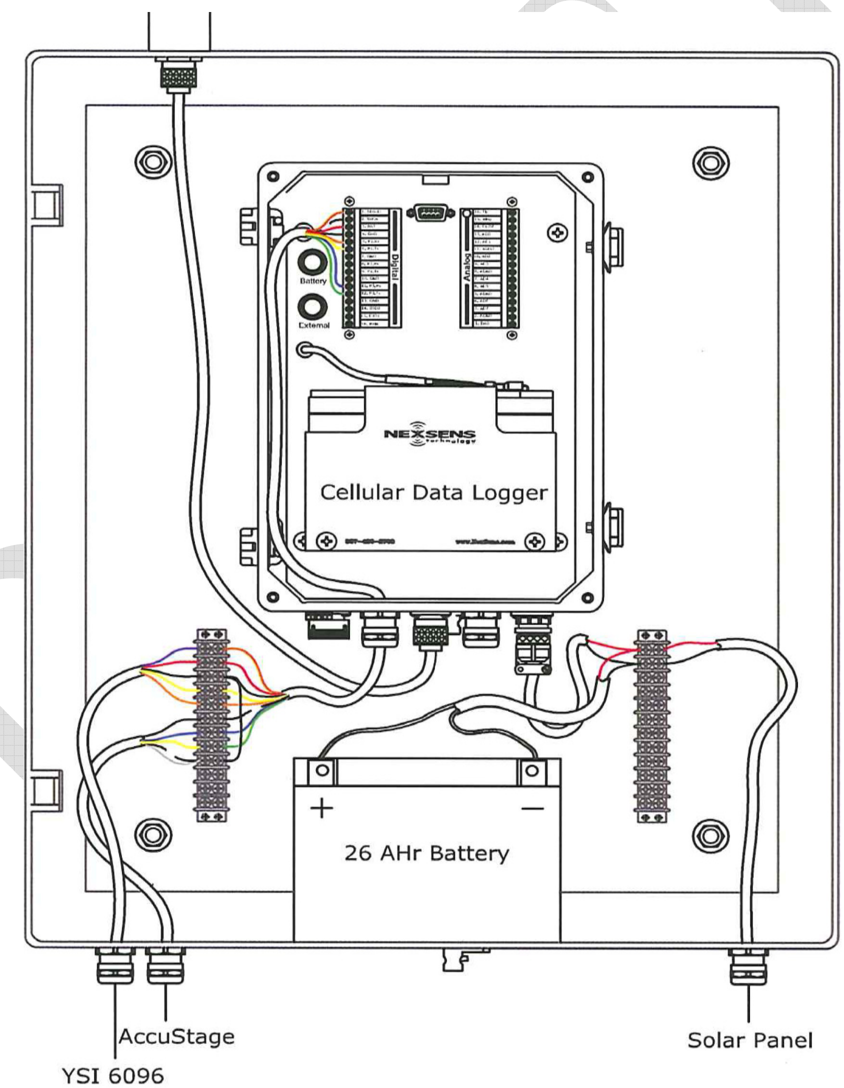


Figure 1. iSIC Datalogger with Steel Enclosure

C. 6600 V2-4 Data Sonde Installation

- PVC pipe is secured in a deep run using a combination of rebar, large rocks, tree roots, hose clamps, coated cable, turn buckles, and cable clamps (Figure 2).
- The SDI-12 cable from the iSIC datalogger unit is connected to the 6600 V2-4 data sonde.
    - The small quick link on the SDI-12 cable is connected to the sonde.
- A safety cable is secured to a fixed object (tree, steel pole, etc.) outside of the scour area.
    - Length of safety cable must be sufficient to span from fixed object to the bottom of the PVC pipe.
    - Secure coated cable around the fixed object with a cable clamp.
    - Opposite end of the safety cable – a small loop is formed with a cable clamp and a quick link is attached.
    - The quick link is attached to the data sonde.
- Data sonde is slid down the PVC pipe.
- Cap is placed on the PVC pipe.

Figure 2. PVC Installation

IV. HEALTH AND SAFETY

Reagents used for calibration of the sonde may be hazardous to your health. Appendix A in the YSI, Inc. *6-Series Multiparameter Water Quality Sondes User Manual* provides safety information on the reagents.

V.6600V2-4 SONDE ASSEMBLY

- It is easiest to install smaller probes (conductivity/temperature, pH) before larger ones (turbidity and dissolved oxygen (DO)).
- Use the probe installation/removal tool for all probe installations in order to minimize finger contact with o-rings. This minimizes the chances of o-rings sliding out of place during assembly and bulging out from their proper places.

A. Supplies Needed for Probe Assembly

- A clean, dust-free table surface that probes can be set down on if needed
- YSI 6570 Maintenance Kit; contains
  - Double-ended probe installation/removal tool
  - Packet of o-rings
  - Krytox (o-ring lubricant)
- Nitrile glove(s)
- Accu-wipes (lens cloths)
- Compressed air can

B. Probe Locations on Sonde Bulkhead

1. Conductivity – small port (with 6-pin connector) to the right of Port C
2. pH – small port (with 4-pin connector) to the left of Port O
3. Turbidity – Optical Port C
4. DO – Optical Port O

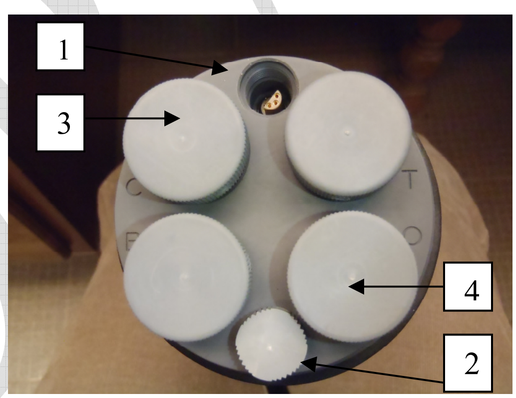


Figure 3. Face of Sonde Bulkhead, with Labeled Optical Ports and Conductivity Port Removed

C. Install pH Probe (Model #6579)

- Remove buffer solution cup, cap, and o-ring from bulb end of probe; remove protective cover from connector end.
- Apply thin layer of Krytox to both o-rings
  - With a nitrile glove on one hand, place a small dot of Krytox on the tip of one finger and rub between finger and thumb. Next, rub finger and thumb around

both o-rings on connector end of probe to apply a thin layer of lubricant. If o-rings look noticeably dusty, you may need to apply Krytox a second time.
    - Be sure to get Krytox on all sides of the o-ring that is closest to rotating nut.
    - O-rings should look moist but not have globs of Krytox. Any globs of Krytox can potentially come in contact with connector and cause contamination.
    - Wipe around o-rings with Accu-wipe to remove any excess Krytox.
    - Ensure top o-ring is directly against rotating nut before installing probe.

Figure 4. Two O-rings Come Standard on All Conductivity and pH Probes

- Remove port plug from small port to the left of Port O on data sonde. Save port plug for later use.
- Ensure port is free of moisture/dust/dirt/Krytox. If moisture or dust is present in port, use rolled-up Accu-wipe and/or compressed air to dry/clean out the port.
- Place pH probe in port by lining up male/female pins.
- Apply downward pressure until you feel probe seat.
- Continue applying the same downward pressure as you tighten nut with long end of tool.
    - If nut becomes tight with large space still remaining between nut and bulkhead, probe may not have seated fully or may be cross-threading. Remove probe, check for cross threading in port, and retry.
- Tighten nut until normal turning pressure no longer easily turns nut.
- If pH probe wobbles, remove probe, re-install, and ensure proper seating. Proper seating and continual downward pressure will minimize wobbling.

D. Install Conductivity/Temperature Probe (Model #6560)

- Using a nitrile glove, apply a thin layer of Krytox to both o-rings as before (see Install pH).
- Remove port plug from small port to the right of Port C on the data sonde using long end of tool. Save port plug for later use.
- Inspect port for moisture/dust/dirt/Krytox as before (see Install pH).
- Line up connectors as before.
- Apply downward pressure until you feel probe seat.
- Continue applying the same downward pressure as you tighten nut using long end of tool.

- Probe nut should rotate loosely until very little space remains between nut and bulkhead.
    - If nut becomes tight with large space still remaining between nut and bulkhead, probe may not have seated fully or may be cross-threading. Remove probe, check for cross threading in port, and retry.
- Tighten nut until normal turning pressure no longer easily turns nut.
    - Probe should not wobble in its socket.

E. Install Optical Turbidity Probe (Model #6136)

- Keep protective cap on probe face until fully installed to prevent any contact with optics.
- A 2nd o-ring will need to be added to connector end, directly below rotating nut.
    - Using nitrile glove, apply small amount of Krytox to all sides of o-ring.
    - Using nitrile glove, slide o-ring up against rotating nut.

Figure 5. Large, Thin O-ring Added to Optical Probes

Figure 6. Large, Thin O-ring Placed Below Rotating Nut on Optical Probes

- Apply thin layer of Krytox to bottom o-ring as before.
- Remove port plug from Port C on data sonde. Save for later use.
- Line up male/female connector in port. Do not press down. Hold probe steady while loosely rotating nut with short end of tool until nut is halfway down into port; then press down on probe; you will hear and feel it seat properly.

- Continue tightening nut while applying gentle, continual downward pressure; nut should continue screwing loosely until o-ring gets close to bulkhead.
- Tighten nut until normal turning pressure no longer easily turns nut.
- O-ring should not be bulging out or protruding; if it is, remove probe, re-lubricate top o-ring, and re-install.

F. Install Optical DO Probe (Model #6150+ ROX)

- Keep protective cap on probe face until fully installed to prevent any contact with optics.
- O-ring installation and probe installation are the same as Optical Turbidity (see above).

G. Tighten Un-used Optical Port Plugs

- Use long end of tool to tighten port plugs in un-used optical ports.

VI.CONNECTING TO SONDE VIA COMPUTER

- In order to connect to sonde via any computer, first install EcoWatch for Windows.
- You will also need a modified SDI-12 cable with USB connector.

VII.ENABLING SENSORS AND PARAMETERS ON NEWLY ASSEMBLED SONDE

- Connect to sonde via EcoWatch.
- On sonde main menu,
  - Select “System” (keystroke 5)
    → Select “Instrument ID” (4) → enter serial # of sonde
    → Select “Date & Time” (1) → ensure date and time are correct
  - Select “Sensor” (7)
    → Disable Time (1)
    → Disable Battery (B)
    → In Optic C (8), enable Turbidity 6136
    → In Optic O (A), enable Dissolved Oxy

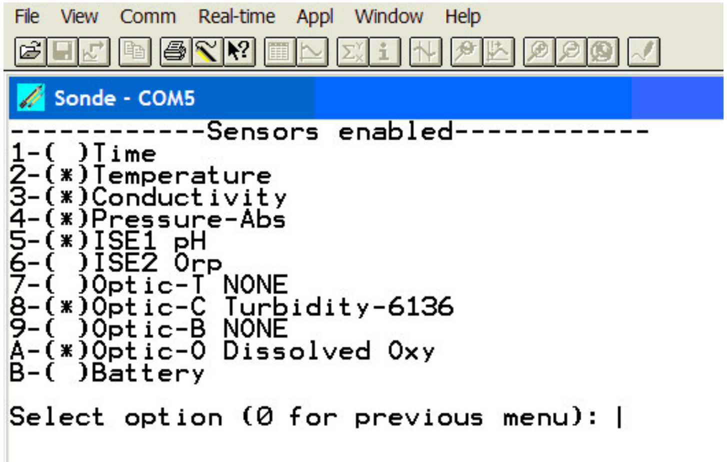


Figure 7. Screenshot of "Sensor" Menu Showing All Enabled Sensors

- Select "Report" (6)
  → Enable ODO mg/L (A)

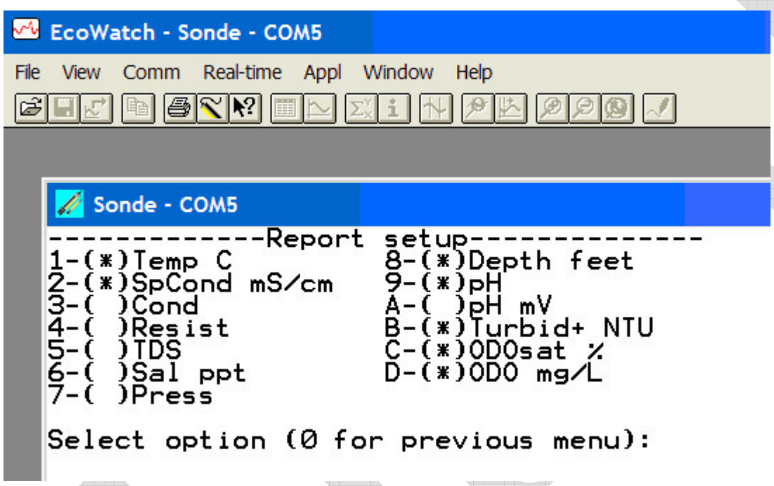


Figure 8. Screenshot of "Report" Menu Showing All Enabled Parameters Used in Sonde Deployment

- Select "Advanced" (8)
  → Select "Sensor" (3)
  → Wipe Interval – change to 15
  → SDI12-M/wipe – change to 15

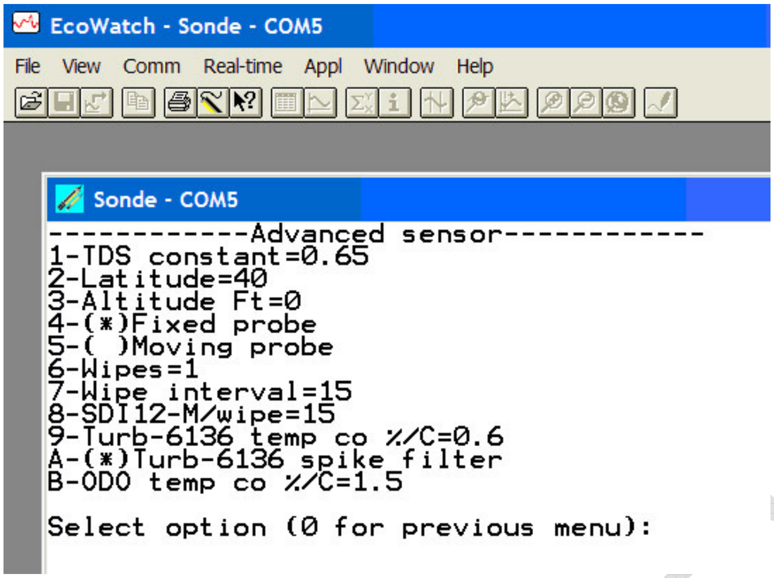


Figure 9. Screenshot of "Advanced" --- "Sensor" Menu Showing Correct Wiper Settings

- All other settings remain the same as set by YSI factory default.

VIII.STORAGE

A. Short-term storage

The sondes are stored in the SRBC lab in the sonde storage area in defined sections (calibrated, needs calibrated, or needs maintenance). The sonde is stored with a calibration cap securely fastened. The calibration cap contains a sponge moistened with tap water to keep dissolved oxygen probes moist and keep pH probes functioning optimally. Short-term storage on a sonde does not exceed 60 days.

B. Long-term storage

Needed if storage will exceed 60 days.
Long-term storage of the probes varies according to parameter.

- The following probes are left in the sonde:
  - Temperature/Specific Conductance
  - Dissolved Oxygen – with electrolyte and membrane in place
  - Tighten a calibration cap with moist sponge over the probes – periodically check to ensure the air is still moist in the cap
- The following probes are removed from the sonde:
  - pH – place it in the storage vessel with pH 4 solution
  - Turbidity – allow to air dry to minimize degradation
  - Place port plugs over portals in which probes were removed

Sonde storage protocol follows the recommendations of YSI, Inc. *6-Series Multiparameter Water Quality Sondes User Manual.*

IX.CALIBRATION

A. In-house calibration

Specific conductance, pH, and turbidity probes are calibrated in-house. Sondes are calibrated in-house no more than seven (7) days prior to deployment. If this time period lapses, sondes are recalibrated before deployment. Calibration information is recorded on a calibration sheet (Attachment A); post-calibration information is also noted on this sheet. The calibration date, person calibrating, and any comments for each sonde calibration are recorded in an Access database. The calibration sheet is scanned and linked to the database as well.

Calibration caps are used for all calibrations. Each standard used in calibration has a designated calibration cup to minimize contamination. The sonde is connected to the lab laptop with a calibration cable and EcoWatch for Windows is open to the main menu. From the main menu in EcoWatch, select 2-Calibrate. Each parameter is calibrated according to YSI, Inc. *6-Series Multiparameter Water Quality Sondes User Manual.* Prior to the initial filling of calibration caps with their designated standard, each cap is rinsed with a small amount of "used" standard saved from previous calibrations. Any wipers present on the optical probes are removed until after calibration of Specific Conductivity and pH. All fresh calibration standards can be reused for a series of successive calibrations, unless dirt particles begin to accumulate in the standard. In between calibrating each parameter, probes are rinsed with water and dried using a lint-free cloth to prevent contamination of the standards.

Calibration Standards Used

- HACH Buffer Solution Phosphate Type (no color added) – pH 7.00
- HACH Buffer Solution Carbonate Type (no color added) – pH 10.01
- HACH Formazin Turbidity Standard – 4000 NTU – used to make 100 NTU standard
  - 12.5 mL of well mixed 4000 NTU in 500 mL volumetric flask; the remaining volume is filled with distilled water
- YSI 3167 Conductivity Calibrator – 1,000 microsiemens/cm

- Specific conductance – one-point calibration. The specific conductance probe is calibrated for SpCond from the conductivity calibration menu. The calibration cap is filled with enough 1.0 mS/cm standard to cover the vent hole in the probe with the sonde in an inverted position and the sonde is rotated to ensure all bubbles are removed from the sensor. Temperature is equalized for at least a minute before calibration process begins. Once the specific conductance readings stabilize, the calibration is accepted and the probe is rinsed in water.
- pH – two-point calibration. Enough buffer standard of pH 7.00 is placed into a short calibration cap; the probe is positioned in an upright position, with the tip of the probe submerged in the solution and the temperature equalizes for at least a minute. The calibration process is started and accepted after the readings stabilize for 30 seconds. The probe is rinsed with water and positioned in a second calibration cup with pH 10.01 buffer standard and the process is repeated.
- Turbidity – two-point calibration, followed by a one-point calibration to prevent negative turbidity readings during field deployment.

- Two-point calibration. Tighten a clean wiper at 180 degrees from turbidity optics. Place approximately 500 mL of 0 NTU standard (distilled water) in a calibration cap and position the probe in the solution. Run the wiper 1-2 times to remove anything from the sensor. Once the readings stabilize, the calibration is accepted. Wipe the probes dry and place in a second calibration cup with approximately 500 mL of 100 NTU standard and repeat the process. Note: the 100 NTU standard may need to be confirmed using a turbidity meter immediately after mixing. If the standard is not 100 NTU, the true value is used in place of 100. In between successive sonde calibrations, the mixed standard will need to be re-agitated by inverting the sonde and connected cup 1-2 times.
- One-point calibration. Following calibration in 100 NTU standard, rinse turbidity probe and wiper with water and place probes back in distilled water (0 NTU). Select one-point calibration and enter calibration standard as 0.5. Run the wiper 1-2 times, wait for readings to stabilize, and accept calibration.

- When all in-house calibration is complete, the pH mV parameter is disabled under "Reports" and a clean wiper with a brush is placed on the dissolved oxygen probe, at 180 degrees from optics. A calibration cap with a moist sponge is placed over the probes until deployment. Conductivity and pH standards used during calibration are saved in clearly marked containers for later use. All calibration cups are rinsed with distilled water to prevent residue build-up.

B. In-field calibration

Dissolved oxygen and depth sensors are calibrated on-site. Calibration occurs directly before deploying the sonde. Calibration information is recorded on a field calibration sheet (Attachment B) and these data are then entered into an Access database.

The calibration cap is used for all calibrations. The sonde is connected to the Toughbook laptop or a YSI 650 Multiparameter Display System (650 MDS) with a calibration cable. If the laptop is used, EcoWatch for Windows is opened to the main menu. Each parameter is calibrated according to YSI, Inc. *6-Series Multiparameter Water Quality Sondes User Manual.*

- Dissolved oxygen – one-point calibration for percent saturation. The probe is placed in a calibration cap with about 1/8 inch of water in it and is vented by not tightening all the threads. Wait 10 minutes to allow the temperature and oxygen pressure to equilibrate. Barometric pressure is needed for calibration. If using the laptop, barometric pressure is recorded from a YSI, Inc. ProODO meter; the YSI 650 MDS handheld records the barometric pressure for calibration. Once the barometric pressure is entered, calibration begins. After the reading stabilizes for at least 30 seconds, calibration is complete.
- Depth – make sure the probe is in air. Pressure-Abs is selected from the calibration menu – we do not have a vented sensor. Zero (0) feet is entered and when the readings stabilize for at least 30 seconds, calibration is complete.

C. Firmware

Firmware updates to the sonde are made as needed. Updates are done in-house and follow the procedure outlined in the YSI *6-Series Multiparameter Water Quality Sondes User Manual.*

X.FIELD DEPLOYMENT

A. Length of sonde deployment

Eight weeks maximum. Alarms have been built into the data platform that email staff when readings are outside of normal ranges. Staff will replace a sonde earlier if a probe malfunctions.

B. Calibration of probes

Done in accordance to the calibration section of this procedure

C. Instream

If there is currently a sonde instream, it is removed first. The sonde is pulled out of the PVC, the field cap is removed and replaced by a calibration cap (moist sponge inside), and the SDI-12 cable is disconnected and replaced with a cap. The date, time, and sonde ID are recorded on a calibration field sheet and then entered into an Access database. The sonde is brought back to the SRBC lab for post-calibration and cleaning.

A calibrated sonde is outfitted with a field cap and the SDI-12 cable is connected to the sonde. The sonde ID and date and time of installation are recorded on a calibration field sheet and then logged in an Access database.

Field water quality parameters are collected each time a sonde is installed. These parameters include: pH, dissolved oxygen, conductance, temperature, turbidity, and a discharge measurement.

XI.POST-CALIBRATION AND SONDE/PROBE CLEANING

A. Post-Calibration

Post-calibration of the probes occurs no more than five (5) days after the sonde is removed from a stream and before the sonde and probes are cleaned (accounts for fouling drift). Post-calibration is completed in the SRBC lab and on the following probes: pH, specific conductance, turbidity, DO, and depth.

Prior to post-calibration, turbidity and dissolved oxygen wipers are removed. If either wipers are missing or are oriented incorrectly (i.e., not 180 degrees from optics), this is noted on the post-calibration sheet.

Post-calibration is completed by placing each of the probes in a known standard solution and then recording what the probe reads. Post-calibration data are recorded on the calibration sheet, which is scanned and placed in an Access database.

B. Cleaning

After a sonde has been post-calibrated, the sonde and the probes are cleaned with water and lens paper, soft cloth, or brush (conductance). A small amount of commercial detergent (Liquinox) is used if necessary. Special attention is paid to make sure the specific conductance cell is cleared of all debris. The depth sensor is also flushed clean using a syringe. After all probes have been cleaned, a clean calibration cap with a moist sponge is placed over the probes; if the sonde is going into long-term storage, the long-term storage procedure is followed.

XII.MAINTENANCE

A. Sonde

- Annual maintenance – sondes are serviced annually by Fondriest Environmental, Inc.
- O-rings – any time an o-ring is exposed, it is visually inspected for defects and lightly greased. If the o-ring is damaged, it is replaced according to guidelines established in the YSI *6-Series Multiparameter Water Quality Sondes User Manual.*
- Probe and cable ports – are covered at all times if they do not have a probe or cable connected to them.

B. Probes

- Dissolved Oxygen – probe is always stored moist. The sensor membrane is only cleaned with moist (water) lens paper. The optical DO membrane is replaced annually (during Fondriest Annual Tune-up) to ensure the most accurate DO readings.
- Temperature – no maintenance is required.
- Specific Conductance – the openings are cleaned with the cleaning brush from the maintenance kit after each deployment/post calibration.
- pH – water and lens paper or a soft cloth are used to remove all debris from the glass bulb. A small amount of commercial detergent is used if necessary. If pH probe is not reading properly after cleaning, there are two additional processes in Section 2 of the YSI *6-Series Multiparameter Water Quality Sondes User Manual* that will be followed. pH probes can become slow to stabilize after one year, so it is recommended that pH probes be replaced annually (during Fondriest Annual Tune-Up).
- Depth – the through-hole above the sonde bulkhead is flushed with water using a syringe.
- Turbidity – the probe face is cleaned with lens paper after each deployment. Wipers are replaced as needed.
- All probes and sondes not correctly reading standards are sent to Fondriest Environmental, Inc. for service or replacement.

XIII.DATA CORRECTION

A. Probe Drifting

- Over time, a probe will experience calibration drift.
- Fouling drift – sediment, debris, and biological growth drift is calculated by post-calibrating the probes in known solutions. The difference between what the probe reads and the known standard value is the fouling drift.
- Instrument drift – the last readings took by the probes instream before removal and replacement are recorded. The first stabilized reading by the probes on the replacement sonde are also recorded. We are able to determine the instrument drift by taking the difference of the two readings and eliminating the fouling drift.
- The drift values are used when correcting the data.

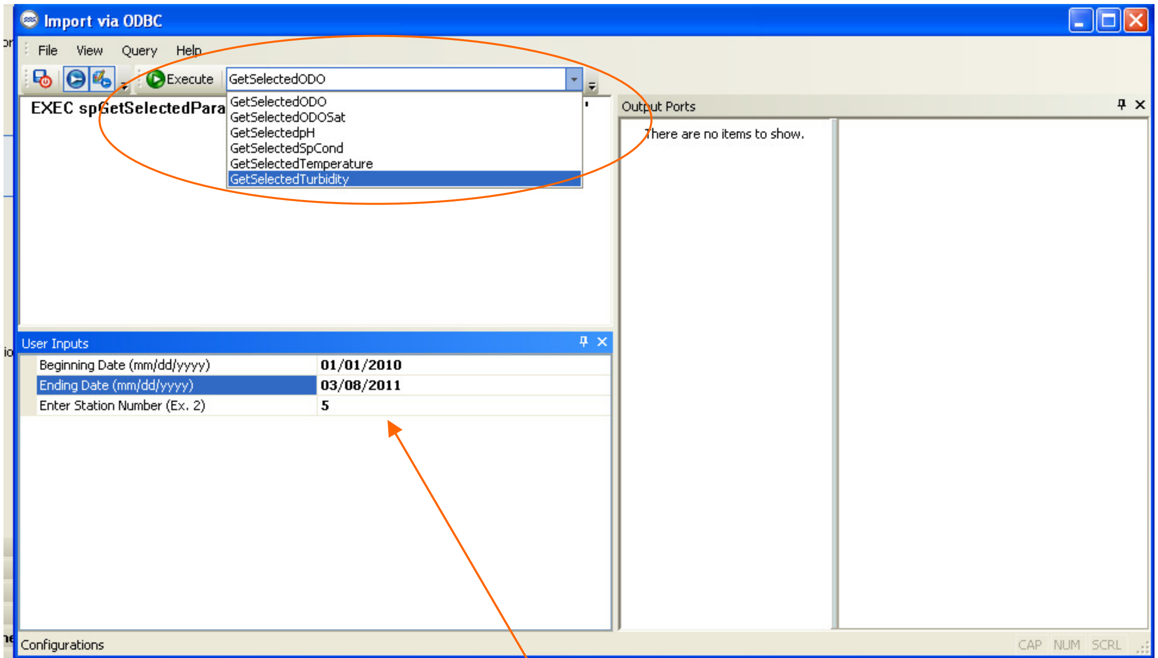
B. Data Corrected

- Drift – data are corrected based on calculated drift.
- Equipment malfunction – invalid data from malfunctioning probes or sondes are eliminated from the dataset.
- Known disturbance – data collected during sonde exchange, station maintenance (in-stream), disturbance during supplemental sampling
    - Data 30 minutes before and after a data sonde are exchanged are removed from the corrected dataset.
- The original dataset remains unchanged; corrections are recorded in a copy.

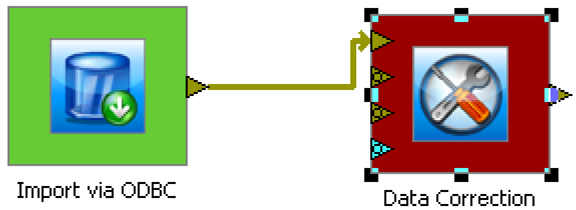
C. Data Correction Software

AQUARIUS 2.7:

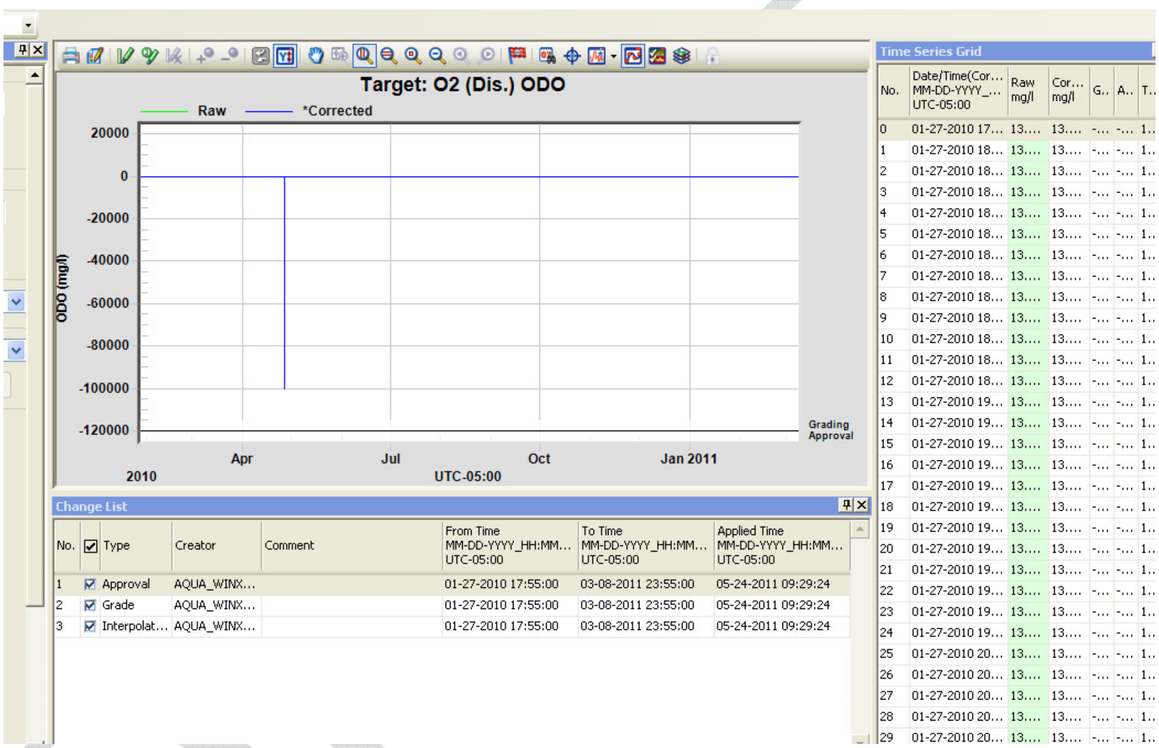
- Open Aquarius software (Toughbook).
    - *Data Input* Toolbox should be open.
    - If another toolbox is open, maximize *Data Input*
- Double-click "Import via ODBC."
    - Green box will appear on the white board.
- Double-click the green box.
    - Opens ODBC import.
- Next to the Execute Button, there is a drop-down menu; Select a parameter.
    - Every parameter will need to be corrected, except for Temperature (currently not working)
    - Begin with SpCond; it is the first parameter you will need to correct



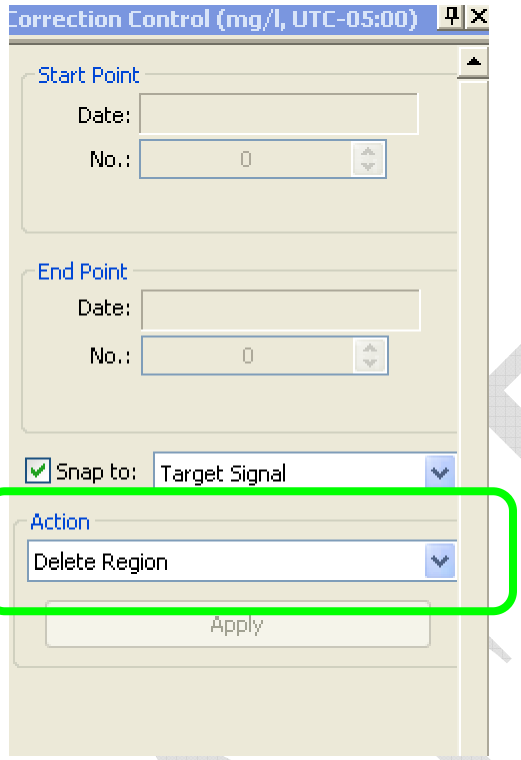
- Fill in the Beginning and Ending Dates for the data record you would like to import and also the station number for the location you are importing.
    - Station Numbers are located in the Sonde Database; Switchboard Menu item – *Data Correction*
    - Use dates from Sonde install to Sonde removal.
        - i.e., Sonde 02 was installed on 4/27/2010 and removed on 7/1/2010 – import data from 4/27/2010 until 7/1/2010.
- Click Execute – the Output Ports area will show parameter to be output.
- Click OK when the password box comes up.
    - Repeat this process for each parameter – dates and station number will stay populated, just select the different parameters
- Close Import via ODBC– click **yes** to the pop-up about applying changes to the output.
- Save the project according to the station name.
    - C:\Data Correction_RWQMN\Corrected Data\"Station Name"
    - Name the file with the Station Name and the start date and end date (i.e BobsCreek_01_01_2010_05_01_2011)
- Maximize Correction on Sidebar.
- Double-click "Data Correction."
    - Brown box will appear on the white board.
    - Repeat this until a Data Correction box is available for all parameters being corrected
- Connect each port (arrow) on the green box to the top port on the brown box.
    - Click on the port on the green box and drag to the top port on the brown box.



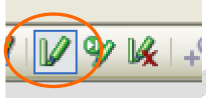
- Double-click the brown box.



- <u>**Data Correction Types – used by SRBC**</u>
  - Delete Region
    - Sonde swaps
    - Probe malfunction
    - Sonde out of water
    - Data previously corrected
    - Data to be corrected in the future
  - Drift Correction
    - Corrects for probe calibration and fouling drift
  - Trim Threshold
    - Deletes data outside of the parameter norms
- Correct Delete Regions area first
  - Select Delete Region on the Correction Control sidebar

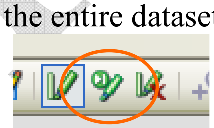


- Mark Region tool (shown below)

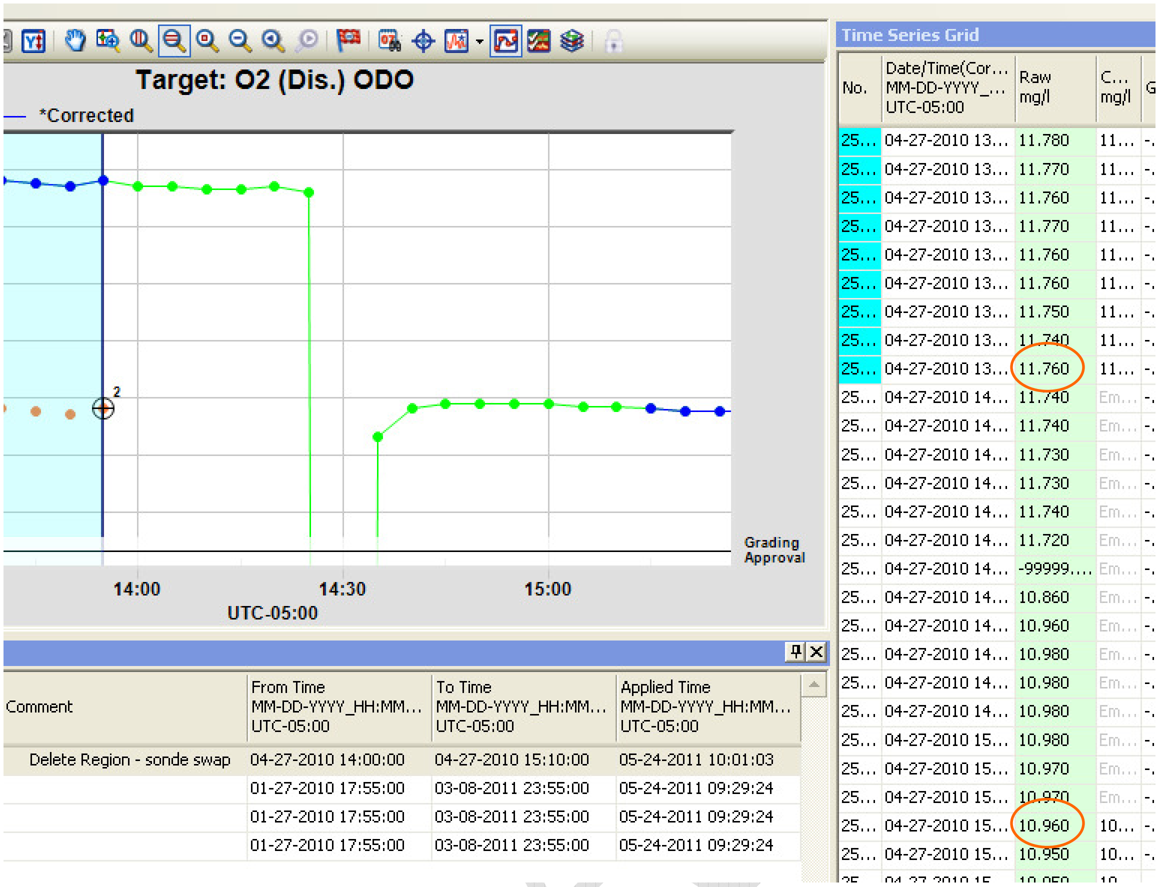


  - There are two ways to select the data to correct
    - Select Exact dates and times
      - Click the Mark Region tool
      - Select the start date and time you wish to delete on the table
      - Hold the Shift key and select the end date and time to delete on the table
      - Area will highlight in pale green on the table and the graph
    - Select any date and time
      - Click the Mark Region tool
      - Click the graph and drag over to select a date and time region – this activates the Start and End date boxes on the Sidebar
      - Enter the correct Start and End date and time in the boxes
      - Area will be highlighted in pale green on the table and the graph
  - **Delete Region Correction**
    - Start Point – 30 minutes before sonde was removed from the stream.
    - End Point – 30 minutes after sonde was placed in the stream.
    - Satellite stations – Delete the 4-hour time period the sonde was swapped in. (i.e., Sonde is swapped at 10:00 am; the noon reading should be deleted)

    - Date/Time information for sonde swaps is found in the Sonde Database.
    - Click “Apply” button after the date/times have been entered.
    - **Change comment to** “Delete Region – sonde swap.” (Type or select comment)
    - Click “Okay.”
    - Corrected points will turn green.
    - Use this process to delete -99999.999 values.
    - Delete regions where sonde was out of water or probe malfunction.
      - DO reading zero
      - Conductance levels of 0.00XX
        - Record date and times – sonde was out of water and the region will need to be deleted from each parameter
  - Delete data previously corrected (all data before the data correction start date and time); Comment – Data previously corrected
  - Delete data after the last sonde swap; Comment – Data will be corrected the next time
- **Trim Threshold**
  - Trim (delete) values outside of the normal parameter value – high and low
  - Low threshold trim values
    - Conductance - <0.001
    - DO - <2.0
    - DO sat - <50%
    - pH - <3
    - Turbidity - <-5
  - High threshold trim values
    - DO - >15
    - DO sat - >120%
    - pH - >14
  - Select “Trim Threshold” in the Action
    - Select low threshold
    - Select the entire dataset



    - Enter the value for low threshold as found above
    - Repeat for high threshold
- **Drift Correction** – probes will begin to drift from calibration after being in the field for several weeks.
  - Calculation of drift
    - Last data point recorded on the “old” sonde (not deleted for the sonde swap correction)
    - First data point recorded on the “new” sonde (not deleted for the sonde swap correction)
    - Drift correction factor for this example = -0.80 (11.76-10.96)



- Correct for Drift
  - In the Correction Control sidebar, select "Drift Correction" in the Action.
  - Select the region for correction (mark the same way as for Delete Region Correction).
  - Dates for Drift Correction
    - Entire length of time sonde was instream (discounting times deleted for sonde swaps).
      - i.e., Sonde 02 was installed on 1/27/2010 at 13:10 and removed on 4/27/2010 at 14:25 – the region selected would be 1/27/2010 at 13:40 until 4/27/2010 at 13:55.
  - Enter the drift factor calculated into the calibration drift on the Correction Control sidebar.
    - If zoomed in, you will see new points appear to correct for the drift.
  - Click "Apply."
  - Click "OK" to accept the comment as written
  - New data points will be in blue and the old will turn green.
  - Repeat for each sonde swap
  - Flag large correction factor regions
    - Select region and add Suspect Flag

Attachment A: Calibration Shet

Pre-deployment calibration

Initials:_________ Date:__________ Sonde: __________

Batteries in unit?	Y	N	Firmware updated?	Y	N
Turbidity Wiper Replaced?	Y	N	Wiper Parks 180 deg from Optics?	Y	N
D.O. Wiper Replaced?	Y	N	Wiper Parks 180 deg from Optics?	Y	N

Cond (meas): __________ Cond (stnd): __________

pH 7.00: __________ pH 7 (mV): __________ Turb (0 NTU): _________

pH 10.01: __________ pH 10 (mV): __________ Turb (100 NTU): _________

pH 4: __________ pH 4 (mV): __________ Turb (0.5) _________

Note: Millivolt span between either pH 4 and 7 or 7 and 10 should be ~ 165 to 180 mV.

Cal Constants (record <u>after</u> calibration):

Param	*Displayed*	*Default*	*Operating Range*	*Comments*
Cond		5	4 to 6	Traditional cell constant
DO gain		1	0.5 to 2.0	
mV offset		0	-100 to 100	
pH offset		0	-400 to 400	
pH gain		-5.0583	-6.07 to -4.22	
Turb offset		0	-10 to 10	
Turb A1		500	0.6 to 1.5	Range is ratio of M1 to A1
Turb M1		500		
Turb A2		1000	0.6 to 1.5	Range is ratio of (M2-M1) to (A2-A1)
Turb M2		1000		

Notes:

Post-deployment check

Initials:_________ Date:__________ Sonde:__________

Cond (meas): __________ Cond (stnd): __________

pH 7.00: __________ pH 7 (mV): __________ Turb (0 NTU): _________

pH 10.01: __________ pH 10 (mV): __________ ODO % Sat.: __________

pH 4: __________ pH 4 (mV): __________ ODO mg/L: __________

BP:__________ mmHg Depth: __________

Notes:

Attachment B: Field Calibration Sheet

Site	**Sonde In**	**Date In**	**Time In**	**Barometric Pressure**	**% DO**	**Sonde Out**	**Date Out**	**Time Out**